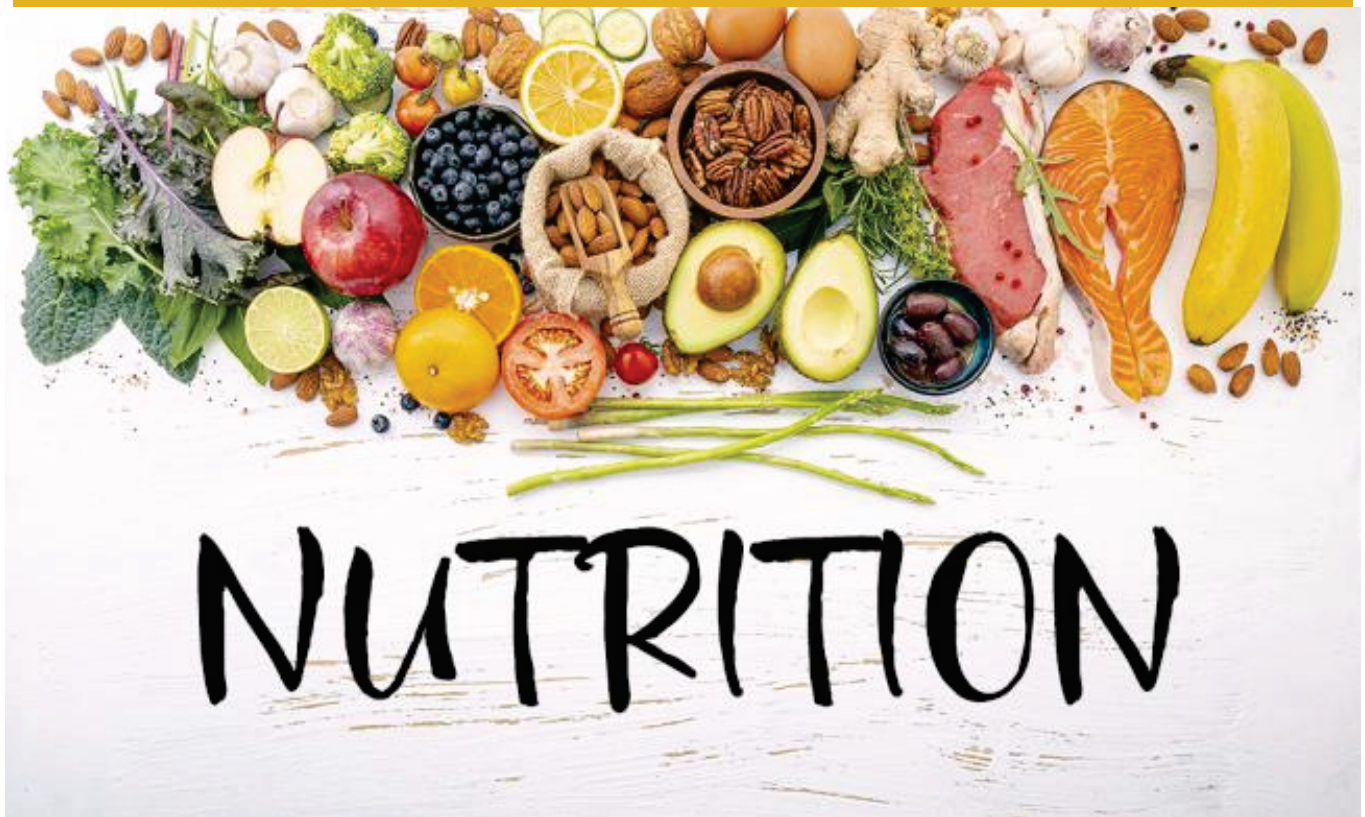


STUDY GUIDE

HEALTH AND NUTRITION

Course Code: 1925



**Department of Nutritional Sciences & Environmental Design,
Faculty of Sciences**

ALLAMA IQBAL OPEN UNIVERSITY, ISLAMABAD

STUDY GUIDE

HEALTH AND NUTRITION

Course Code 1925

UNITS 1-9

Course Coordinator

Dr. Mahpara Safdar



**Department of Nutritional Sciences and Environmental
Design**

Allama Iqbal Open University, Islamabad

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Year of Printing 2025

First Edition 2025

Quantity: 1000

Layout by Ummad Ahmed Shad

Incharge Printing Press Dr. Sarmad Iqbal

Printer AIOU ,Islamabad

Publisher AIOU ,Islamabad

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INTRODUCTION

This course consists of 9 units composed in the form of a study guide. The course will provide students with an understanding about basic food nutrients, their daily nutritional requirements and recommended amounts, infant nutrition, impact of cooking on food nutrient levels, food microorganisms having advantages or disadvantages, food and waterborne illnesses, worm-transmitted diseases, prevalent health issues in Pakistan and their dietary remediation, importance of dietary modifications in different health conditions, and role of nutrition education to uplift the health status of the community.

OBJECTIVES

1. To explain the digestion and absorption of nutrients from food
2. To familiarize the students with the connection between nutrient consumption and their metabolism
3. To describe the protein and energy requirements
4. To discuss about the food microorganisms with their advantages and health hazards
5. To comprehend the relationship between worm infestation and dietary habits and prescribe precautionary measures.
6. To promote therapeutic foods for patients having various diseases
7. To identify commonly prevailing diseases in Pakistan and their remedy through modified diets

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FOREWORD

It is a pleasure to introduce this comprehensive study guide for the '*Health and Nutrition*' course offered by the Department of Nutritional Sciences and Environmental Design at Allama Iqbal Open University. We are committed to providing students with the knowledge and skills they need to address persistent health concerns in our communities and beyond. Health and nutrition play a critical role in enhancing quality of life, supporting physical development, and preventing a range of diseases.

This course has been thoughtfully designed to cover a wide spectrum of topics essential for understanding the role of nutrition at every stage of life from infancy to adulthood, and its impact on disease prevention and management. Beginning with fundamental concepts such as determining daily nutrient requirements and understanding Basal Metabolic Rate (BMR), the curriculum covers all complex areas, including infant nutrition, food safety, food-borne diseases, and the effects of cooking on nutrients.

In addition, the course addresses prevalent health issues in Pakistan, such as diabetes, obesity, and goiter, offering insights into dietary modifications and nutritional strategies to manage these conditions. Furthermore, a unit on nutrition education and community-based nutrition programs underscores the importance of spreading knowledge within society to foster healthier lifestyles.

We hope this course will encourage students to make informed choices for themselves and to educate others on the importance of balanced nutrition and preventive health practices. You will find this course enriching and beneficial on your journey towards becoming a health and nutrition promoter/expert.

With best wishes,

Prof. Dr. Nasir Mehmood
Vice Chancellor

PREFACE

Welcome to the Health and Nutrition course, a key component of your academic journey in the Faculty of Sciences. As the Dean, I am pleased to introduce this study guide, designed to provide you with a comprehensive foundation in the essential principles of nutrition and its profound impact on health.

In this course, you will explore the scientific basis of nutrition, examining the vital role that nutrients play in maintaining optimal health and preventing disease. From understanding the daily nutrients requirements to exploring the complex relationship between diet, lifestyle, and chronic conditions, this course will equip you with the knowledge necessary to make informed decisions regarding health and well-being.

Nutrition is an ever-evolving field, and we aim to provide you with up-to-date information, critical thinking skills, and practical knowledge that you can apply in various professional settings. Our goal is not only to foster your academic growth but to inspire you to contribute to improving the health and nutrition of individuals and communities around the world.

I encourage you to approach this course with curiosity, an open mind, and a commitment to learning. Together, we can explore the transformative power of proper nutrition and its vital role in leading a healthier life.

Wishing you all the best in your studies!

Sincerely,

Prof. Dr. Muhammad Sher
Dean, Faculty of Sciences

WELCOME MESSAGE

Dear Students,

It is my great pleasure to welcome you to the Health and Nutrition course, a vital part of your academic experience in the Department of Nutritional Sciences and Environmental Design. As the Head of the Department, I am excited to introduce this study guide, which serves as your roadmap to understanding the crucial relationship between nutrition and overall health.

Throughout this course, you will delve into the science of nutrition, exploring how the foods we consume influence our health and well-being. You will study about the simple concepts of food and water borne diseases and the complex interactions between diet and disease prevention, and food microbiology and its role in human health. This course will provide you with a robust understanding of how food and nutrition shape human health.

I encourage you to approach this subject with enthusiasm and a sense of curiosity, as the knowledge gained here will not only enhance your academic growth but also empower you to make meaningful contributions to improving health outcomes in society.

Your commitment and passion for learning will be key to your success in this course. We are here to support you every step of the way, and we look forward to your continued progress and achievements.

Wishing you all the best!

Sincerely,

Dr. Zaheer Ahmed
Chairman, Department of Nutritional
Sciences and Environmental Design

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to everyone who contributed to the development of this study guide for the Health and Nutrition course. This guide would not have been possible without the support, expertise, and dedication of all individuals who were involved in its development.

First, I would like to extend my sincere thanks to our esteemed Vice Chancellor, whose leadership and vision have been instrumental in fostering academic excellence and supporting the growth of our department and curriculum.

A special note of appreciation goes to the Dean of the Faculty of Sciences, whose guidance and encouragement have ensured that this course continues to provide students with a solid foundation in health and nutrition.

I would also like to thank the Head of the Department for his unwavering support and strategic oversight throughout the development of this study guide, ensuring it aligns with our department's standards of academic rigor and quality.

This guide would not have been as comprehensive without the expertise and hard work of the writers, whose deep understanding of the subject matter helped create a detailed, relevant, and engaging curriculum for our students. I am also grateful to the reviewers for their valuable feedback, which allowed us to refine and enhance the content.

A heartfelt thank you to the editors who meticulously reviewed and fine-tuned the text, ensuring clarity and coherence, and to the designers who made the guide visually appealing and user-friendly. Finally, my appreciation extends to the printers for producing this guide, making it accessible to all students.

To all of you, your contributions have been invaluable in bringing this study guide to life, and I am truly grateful for your dedication to advancing the education and well-being of our students.

With sincere thanks,

Dr. Mahpara Safdar
Course Coordinator

UNIT 1

DETERMINATION OF DAILY NUTRIENTS' REQUIREMENTS AND THEIR RECOMMENDED AMOUNTS

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1.1 INTRODUCTION

In this unit, the daily nutrient requirements of individuals have been discussed. Also, it has been mentioned how much energy the human body needs during different situations in life. In previous classes you have studied various aspects of energy use, but in this unit, we will cover this important topic in more detail. The nutritional needs according to age and work as determined by the international organizations and the Pakistani organizations are mentioned. Ways to find the total energy needs are also discussed.

1.2 OBJECTIVES

After reading this unit you will be able to:

1. Explain basal metabolic rate and factors influencing it.
2. Know about energy requirements for basic metabolic rate.
3. Determine physical nutritional needs by understanding the energy requirements for different tasks.
4. Learn about the effects of age, sex, weather, etc. on the BMR,
5. Determine the nutritional needs of people of different age groups with reference to weight and height.

1.3 BASAL METABOLIC RATE

The main purpose of eating food is to provide the body with fuel that is needed for the proper functioning of the human body. For a living man, a certain amount of energy is always available in the body for on-going natural processes of the body such as beating of heart, pumping of blood through arteries, and breathing. Due to the continuation of these three processes, the blood receives oxygen through the respiration process and that oxygen along with digested nutrients goes through many successive chemical changes. These chemical changes are known as **basal metabolic rate (BMR)**. This process continues throughout and provides the body with the energy needed to perform specific functions. Energy required to maintain basal metabolic rate either comes from intake of daily food or obtained through energy from digestion of excessive carbohydrates stored in the form of glycogen in the body. In the absence or deficiency of both sources, energy is taken from stored fats. Experiments have been made clear that the body can use its 40% of energy with reference to weight to maintain these factors, but further reduction in weight should not be more than that, otherwise the body becomes thin due to lack of food.

Basal Metabolic Rate (BMR), also known as RMR (Resting Metabolic Rate), refers to all the changes that occur on food after passing through the digestive system and the absorptive system, which continue to occur in the human body even at a resting state. Energy expended during this state per unit time is called the Basal Metabolic rate.

Experiments have proved that a person with a normal average weight of 70 kg and average height of 185 cm requires 293 kilojoules of energy for BMR, i.e. 70 calories per hour or 1680 calories per day.

The energy required for BMR depends on the following factors:

- | | |
|---|------------------------------|
| 1. Weight and height | 2. Age |
| 3. Insufficient or Inadequate nutrition | 4. Gender |
| 5. Activity factor | 6. Weather |
| 7. Thyroid Gland | 8. Special immediate impacts |

1.3.1 Impact of Weight and Height on Basal Metabolic Rate

You have read about the importance of height and weight for a healthy person and how to measure it in previous classes. Energy required for a BMR of a person is already described earlier. Energy requirements for a low weight or overweight person can be calculated from the following table:

Table No. 1: Energy needs according to weight and height.

Weight	Height	Energy Requirement for Basal Metabolic Rate			
		Per Hour (KJ)	Per Hour (Cal)	Kilojoule	Kilocalories
80	188	313	75	7560	1798
75	185	304	73	7280	1747
30	183	293	70	7030	1680
95	180	262	67	6650	1613
60	178	270	64	6470	1546

1.3.2 Impact of Age on BMR

If energy requirements for BMR of children, adolescents, and adults are compared, it is concluded that requirements of children and adults are more as compared to adolescents. This requirement is highest at the age of one year and by the age of 20; this rate is equal to the rate of a person having 183 cm height and 80 kg weight. Apart from it, the impact of gender on it also becomes clear after the age of 30.

If a man having 80 kg weight and 183 cm height has a daily energy requirement for BMR is 100 kilo joule/g, then the following changes would have occurred in his needs over a period of one to 20 years.

Table No. 2: Height according to gender and age

Age (years)	Height (cm) and Gender	
	Boy	Girl
1	137	137
3	133	133
5	127	125
7	123	117

9	117	111
11	111	109
13	109	104
15	106	95
17	105	94
18	102	92
20	100	91

1.3.3. Impact of Insufficient or Improper Nutrition on BMR

You have been told before about the dependence of basal metabolic rate on body weight. So, it will be more in obese people as compared to thin adolescents due to difference in body weight. Thus, if an overweight person is not taking sufficient food for a period of long-time, then the fat stored in his body begins depleting so that to be used for this purpose and then gradually his nutritional requirements will also decrease. And finally, the energy requirements for basic metabolism rate will also be reduced.

Experiments have proved that when people are forced to starve for a long period of time, this rate is reduced by 60%. But amount more than that can also cause other diseases and even death. It is a very complex process and considers it as a gift of nature that a body adapts itself according to the amount of energy required for chemical reactions. It also shows how the people of ancient times made themselves rely on available food to pass their life.

1.3.4. Impact of Gender on BMR

In literacy meaning, a woman has been called a fragile gender. This is not just a metaphor, but it is a fact that women are not able to do the laborious work that men can do. Even if she does, she cannot do it with the same speed and ease as a man can do because women naturally have a lower basal metabolic rate. From the age of three, females require less energy than males for basic metabolism, and in general, females weigh less than males of the same age. According to table No. 3, the energy required for basic metabolism in women is less with reference to weight, and since this energy is equal to 85% of the total energy requirements, the total energy requirements of women are also lower than those of men. However, when the energy required for work and other natural phenomena such as childbirth and breastfeeding, etc., the situation would be different.

Table No. 3: Energy requirements according to gender and age

Men					Women					
Age	Wt.	Energy req/kg b.w. /day		Energy req/person/day	Wt.	Energy req/kg b.w. /day			Energy req/person/day	
Years	Kg	Cal	Joule	Cal	Joule	Kg	Cal	Joule	Cal	Joule
1	7.3	112	470	820	3.4	7.3	112	470	820	3.4
1	11.4	103	431	1180	4.9	11.1	106	444	1180	4.9
2	13.6	100	418	1360	5.7	13.4	100	418	1350	5.6
3	15.6	100	418	1560	6.5	15.4	99	414	1520	6.4
4	17.4	99	414	1720	7.2	17.5	96	402	1670	7.0
5	20.7	91	381	1870	7.8	20.0	90	377	1790	7.5
6	23.2	87	364	2010	8.4	22.4	85	356	1900	7.9
7	25.9	83	347	2140	9.0	25.0	80	335	2010	8.4
8	28.6	79	331	2260	9.5	27.6	76	318	2110	8.8
9	31.3	76	318	2380	10.0	30.4	73	305	2210	9.2

10	33.9	74	310	2500	10.5	33.8	68	285	2300	9.6
11	36.7	71	297	2600	10.9	37.7	62	259	2350	9.8
12	40.2	67	280	2700	11.3	42.4	57	238	2400	10.0
13	45.5	61	255	2800	11.7	47.0	52	218	2450	10.3
14	51.7	56	234	2900	12.1	50.3	50	209	2500	10.5
15	56.6	53	222	3000	12.6	52.3	48	201	2500	10.5
16	60.3	51	213	3050	12.8	53.6	45	188	2420	10.1
17	62.4	50	209	3100	13.0	54.2	43	180	2340	9.8
18	63.7	49	205	3100	13.0	54.6	42	176	2270	9.5
19	65.0	47	197	3020	12.6	55.0	40	167	2200	9.2
Average	65.0	46	192	3000	12.6	55.0	40	167	2200	9.2

1.3.5. Impact of Activity Factor on BMR

A large portion of our daily nutritional needs are required for the purpose of daily activities, it is also known as professional needs. Whenever we do something, the muscles of our body move and due to it, movement in organs also happens. This requires energy. The more physically demanding the work, the more energy will be

required. Scientists have done various experiments to find out the energy required for various tasks performed by an average person (see table no. 4).

But remember that there may be some shortcomings in it from an individual point of view because firstly, the weight of working people will be different from one another and secondly, their ability to do work will also be different. For example, to ride in a moving car requires much less energy for a light athletic young person than for a heavier person who can't even run some steps. However, the below table is designed for an average person and of course can be of good use. Also, in this table, the tasks are divided into sedentary, medium, and heavy tasks. If requirements for a specific task are not mentioned in it, that can be assumed by considering relevant task's requirements. In a moderately active individual half of the consumed energy expended at resting state and the rest of the energy is spent during doing work. In addition, muscles also require energy to maintain the proper functioning of the human body.

Energy Requirements per hour

Table No.4: Calories requirement according to activity factor

Sedentary Work	Joule	Kcal
Sitting	63	15
Writing	84	20
Standing	84	20
Typing	16-40	67-167
Sewing Clothes	138	33
Wearing Clothes	138	33
Changing Clothes	167-209	40-50
Driving	247	59
Washing Dishes	247	59
Book Covering	180-376	43-90

Moderate work

Making shoes	383-481	82-115
Cleaning floor	351-460	84-110

Sweeping	460	110
Washing clothes	514-894	124-214
Walking	523-1003	130-240
Whitening or bleaching	1170-1672	280-400

Heavy work

Polishing	727	174
Cycling	752-2508	180-600
Swimming	896-2926	200-700
Marching	1170-1672	280-400

lot of hard work

Working in a coal mine	1338	320
Breaking stone	1379	330
Wood cutting	1756	420
Jogging	2362	565
Running	3344-4184	600-1000
Climbing stairs	4184	1000

1.3.6. Impact of Weather on BMR

Along with age, gender and work, the weather also has numerous impacts on the basal metabolic rate of the human body. We can guess it by common observation, as in winter our desire is to eat meat and nuts more because the energy stored in a body is spent more in winter as compared to summer. That's why more calories are required. On the contrary, energy is not consumed much in summer, but the body loses more water due to evaporation. Therefore, thirst is more, and drinks are used most during summer.

1.3.7. Impact of Thyroid Gland

If the functioning of thyroid gland in the body is disturbed, then its secretions also decrease. The rate of energy for BMR is generally less in these types of people and thus their movement and thinking power reduces as compared to others.

Likewise, when the functioning of thyroid gland is quite well, its secretion also increases. In this case, the energy rate for BMR has increased by almost 20%. Such types of people are more sensitive and their physical and mental movements become more active and speedier. In this type of situation, the body's stored energy ends soon, and they remain thinner and taller. Remember that an adequate amount of iron is required in diet for proper functioning of thyroid glands.

Some people used this characteristic of thyroid gland and especially its secretion for the purpose of weight loss and somehow succeeded, but experiments made it clear that by doing so led to many other adverse impacts on health. Therefore, this method of weight loss is avoided worldwide.

1.3.8. Immediate Special Impacts

This term describes the special impacts of food during the metabolism processes in which the BMR is fastest during fasting. For example, abundant consumption of proteins sometimes produces immediate and special impacts. Thus, the excess energy produced in the body is immediately lost. In contrast, the energy provided from a moderate diet is used for the body's other functions.

1.3.9 Self-Assessment Questions

Question: Mark the wrong and right statements.

- 1- There should be a certain amount of energy for the body all the time to maintain the basic functions of the body such as pumping of the heart, flowing of blood through the arteries and on-going breathing process.(**true / false**)
- 2- The BMR continues all the time. (**true / false**)
- 3- BMR dysfunctions while sleeping or lying down in a calm state.(**true /false**)
- 4- The energy requirement for a BMR of a person of average weight and height is 293 kilojoules, which means 70cal per hour. (**true / false**)
- 5- The rate of energy requirement for BMR is less in children as compared to adolescents.(**true / false**)
- 6- Stored fats in the body begin depletion, to be used for the fulfillment of energy requirements for the continuation of the body's metabolism during nutritional deficiencies.(**true / false**)
- 7- If the functions performed by the thyroid gland in the body are disturbed, then the secretions of it do not decrease. (**true / false**)

Key for self-assessment activity

For answers refer below given sections

1. 1
2. 1
3. 1
4. 1.1

5. 1.2
6. 1.3
7. 1.7

Practical

Use the Harris-Benedict Equation to calculate the BMR for the following individuals. Assume the individuals are of average age (30 years) and gender-specific as male.

Fill in the BMR for each individual in the table provided below.

Harris-Benedict Equation:

- **For men:**

$$\text{BMR} = 88.362 + (13.397 \times \text{weight in kg}) + (4.799 \times \text{height in cm}) - (5.677 \times \text{age in years})$$

$$\text{BMR} = 88.362 + (13.397 \times \text{weight in kg}) + (4.799 \times \text{height in cm}) - (5.677 \times \text{age in years})$$

- **For women:**

$$\text{BMR} = 447.593 + (9.247 \times \text{weight in kg}) + (3.098 \times \text{height in cm}) - (4.330 \times \text{age in years})$$

$$\text{BMR} = 447.593 + (9.247 \times \text{weight in kg}) + (3.098 \times \text{height in cm}) - (4.330 \times \text{age in years})$$

Data for Calculation:

Individual	Weight (kg)	Height (cm)	Age (years)	BMR (men)	BMR (women)
1	80	188	30		
2	75	185	30		
3	30	183	30		
4	95	180	30		
5	60	178	30		

1.4 REQUIREMENTS OF PROTEINS & CALORIES

The requirements of proteins and calories are different according to work and gender at each stage of life. Proteins are used for the buildup and break down of the body's tissues.

1.4.1. Requirements of Children

Children need more proteins and calories in reference to rapid growth and development, and the rapid breakdown of tissues during childhood. That's why their requirements are 2 to 3 times more as compared to adolescents. As you know, in our country, the body's composition e.g., weight and height of people with reference to age is different from other countries. In addition, geographical conditions and weather are also different, that's why requirements of proteins and energy are different. From the data given in table no.5, you may get to know how much protein and calories per day should be given to growing children in our country. In this section of the unit, the amount of proteins and calories required with reference to age determined by international organizations is mentioned. So, you can compare and use the amount determined by Pakistani organizations.

(You should see table no. 5 for both)

Table No 5 (a): International standards of proteins and energy for different people according to weight.

Age	Weight (Kg)		Energy (Cal)		Proteins (g)	
0-3 months	5.5		660		11	
4-5 months	6.8		782		12.24	
6-8 months	8.0		915		20	
9-11 months	9.5		1000		20	
0-1 year	8.2		1200		24	
0-2 year	10.4		1300		28	
0-3 year	12.2		1350		30	
0-4 year	14.4		1300		35	
5-6 year	17		1580		26	
7-9 year	23		1840		30.6	
	Boys	Girls	Boys	Girls	Boys	Girls

10-12	30	28	2100	2000	36.6	32.2
13-15	45	40	2500	2200	49.5	38.0
16-19	58	44	2900	2100	52.8	36.5
20-39	-		-		-	
40-49	-		-		-	
50-59	-		-		-	
60-69	-		-		-	
70+	-		-		-	
Year	Weight (kg)		Energy (call)		Proteins (g)	
Less than 1 year	7.3		820		14	
1-3	13.4		1360		16	
4-6	20.2		1830		20	
7-9	28.1		2190		25	
	Boys		Girls	Boys	Girls	
10-12	36.9		38	2600	2350	30
13-15	15.3		49.9	2900	2490	37
16-19	62.9		54.4	3070	2310	38
Adults	Men		Women	Men	Women	
Moderate work	65		65	3000	2200	37
Pregnant (Last trimeste)					350+	38
Lactating mother					550+	46

(First 6 months)						
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Table No 5(b): Pakistani standards of requirement and quantity of protein and energy for different Pakistani people according to weight.

Age	Body Weight		Energy		Proteins	
Months and years	Kilogram		Calories		Gram	
0-3 months	5.5		660		11	
4-5 months	6.8		782		12.24	
6-8 months	8.0		915		20.0	
9-11 months	9.5		1000		20.0	
1 year	8.2		1200		24.0	
2 years	10.4		1300		28.0	
3 years	12.4		1350		30.0	
4 years	14.4		-		35.0	
5-6 years	17.0		1580		26.0	
7-9 years	23.0		1840		30.6	
	Boys	Girls	Boys	Girls	Boys	Girls
10-12	30	28	2100	2000	36.6	32.2
13-15	45	40	2500	2200	49.5	38.0
16-19	58	44	2900	2100	52.8	36.5
20-39	-	-	-		-	
40-49	-	-	-		-	
50-59	-	-	-		-	
60-69	-	-	-		-	
70+	-	-	-		-	

1.4.2 Requirements of Adolescents

Requirement of proteins and calories in boys and girls increases at puberty. The requirements depend on their weight and the nature of work. While using proteins at this age, it is important to take care of the maintenance of quality of proteins. In addition to it, other nutritional ingredients are also considered So that protein works properly in the body i.e., build-up and breakdown of tissues. During the 20-39 years of age, the energy requirements of men and women decrease by 5%, and by 10% until the age of 70.

1.4.3. Requirements of Pregnant and Lactating Women

It has been estimated by considering the additional needs of pregnant and lactating women that such women need additional 9 grams of protein and 750 calories per day.

Table No 5 (a) and table no. 5 (b) contain quantities of proteins and energy according to the standards of international and Pakistani organizations. If you keep these additional requirements in mind, then you can calculate the daily nutritional requirements easily and be able to provide useful advice to someone when needed. It can also provide you with better opportunities to work in public health fields later in life.

1.5 REQUIREMENTS OF VITAMIN AND MINERAL AND CHANGES IN IT

As mentioned earlier, various organizations have determined the vitamins and minerals requirements of individuals based on their weight and age. These institutions include international institutions and institutions of Pakistan. Because Pakistani people are different from people of other countries in terms of body structure and weight. Therefore, the needs of different people depending on their weight are also different from people of the same age in other countries. It is for this reason that the quantities given in the western books of food and nutrition are different from the Pakistani books, that's why we have here presented the quantities prescribed by both Food and Agricultural and World Health Organization and Pakistani institutions for the purpose of comparison (table No.6). Students are expected to remember Pakistani standards in mind and use international standards for the purpose of comparison.

1.5.1 Requirements of Children

From birth to 4 months of age, the infant's needs for vitamins and minerals have been met by breast milk. But after that, the needs of vitamins and minerals increase

(such as vitamins A, D, C, calcium, etc.) as all these nutrients impact the growth and development of the child. Table No. 6 (a), 6 (b), 7(a) & 7(b) contain the requirements of prescribed quantities for various ages.

1.5.2. Requirements of Adolescents

Due to the growth and development of the body, the needs of vitamins and minerals also increase. During this stage, as the height increases, the bones require more calcium. Iron must be included in the diet because it helps in blood formation. Girls and women need more iron than men due to loss during menses. According to the opinion of experts, if a balanced diet is consumed, then we can easily fulfill the nutritional requirements of vitamins and minerals.

1.5.3 Requirements of Pregnant and Lactating Women

As pregnant and lactating women need more calories than a normal woman. Likewise, their need for vitamins and minerals also increases. Pakistani women usually need extra iron during pregnancy, as iron deficiency is prevalent among the mother's during pregnancy and breastfeeding period, so if two milligrams of iron is added to their daily diet, the additional requirements can be fulfilled.

During pregnancy and lactation, mothers are advised to drink milk to meet the additional requirement of calcium. So that the needs of both mother and baby are fulfilled. Among the vitamins, it is important to consider the additional requirement of vitamin A, D and C. So that additional requirements of these nutrients can be met by consuming foods rich in these nutrients.

Table No. 6 (a): Standard amount and requirements of vitamin for different individuals according to age.

Year	Vit. A (µg)	Vit D (µg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Folate (mg)	Vit. B12 (mcg)		Vit. C
Less than 1 year	300	10	0.3	0.5	5.4		60	0.3	20
1-3	20	10	0.5	0.8	9.0		100	0.9	20

4-6	300	10	0.7		1.1	12.1		100	1.5	20	
7-9	400	2.5	0.9		1.3	14.5			1.5	20	
10-12	575	2.5	Boys	Girls	Boys	Girls	Boys	Girls	100	2.0	20
			1.0	0.9	1.6	1.4	17.2	15.5			
13-15	725	2.5	1.2	1.0	1.7	1.5	19.1	16.4	200	2.0	30
16-19	750	2.5	1.2	0.9	1.8	1.4	30.3	15.2	200	2.0	30
Adult	750	2.5	Men	Women	Men	Women	Men	Women	200	2.0	30
			1.2	0.9	1.8	1.3	19.8	14.5			
Pregnant women last trimester	750	10		0.1+		0.2+		2.3+	400	3.0	50
BF Women first 6 months	1200	10		0.2+		0.4+		3.7+	300	2.15	50

(Source: Report made by food and agricultural and world health organization committee).

Table No. 6 (b): Standard amount and requirements of vitamin for different individuals of Pakistan according to weight.

Age	Wt. in kg	Vit A (µg)	Vit D (µg)	Vit E (IU)	Niacin (mg)	Vit C (mg)	Vit B1 (mg)	Vit B2 (mg)	Vit B6 (mg)	Vit B12 (mg)
3 months	5.5	0	10	4	3.6	20	0.4	0.4	0.2	0.3
4-5 months	6.8	0	10	5	5.0	20	0.5	0.5	0.3	0.3

6-8 months	8.0	300	10	5	6.0	20	0.7	0.5	0.5	1.0
9-11 months	9.5	300	10	7	7.0	20	0.9	1.0	0.7	1.5
1 year	8.2	300	10	12	10	20	1.3	1.4	1.6	8.0
2 years	10.4	300	10	12	10	20	1.2	1.4	1.3	3.0
3 years	12.2	300	10	12	-	-	1.3	1.4	2.0	3.0
4 years	14.4	400	5.0	12	10	20	1.4	1.5	2.0	3.0
5 years	16.6	450	5.0	12	10	20	1.4	1.3	2.0	3.0
6 years	18.4	-	-	-	-	-	1.3	1.2	2.0	3.0
7 years	20.6	450	2.5	12	10	20	1.2	1.0	2.0	3.0
8 years	22.5	500	2.5	12	10	20	1.0	0.9	2.0	3.0
9 years	23.7	500	2.5	12	10	20	1.3	1.2	1.6	3.0
Boys										
10-12 year	35.0	575	2.5	12	17.0	20	1.2	1.1	2.0	3.0
13-15 year	48.0	725	2.5	12	19.1	30	1.1	1.0	2.0	3.0
16-19 year	58.0	750	2.5	12	20.0	30	1.0	1.0	2.0	3.0
Girls										
10-12 year	34.0	575	2.5	12	15.5	30	1.0	1.0	2.0	3.0
13-15 year	42.0	725	2.5	12	16.4	30	1.0	1.0	2.0	3.0
16-19 year	48.0	750	2.5	12	15.2	30	0.3	0.8	2.0	3.0

Table No. 7 (a): Recommended minerals requirements of individuals according to different age group

Age in years	Weight in kg	Calcium (g)	Iron (mg)
Less than 1 year	7.3	0.5-0.6	5- 10

1-3	13.4		0.4-0.5	5-10	
4-6	20.2		0.4-0.5	5-10	
7-9	28.1		0.4-0.5	5-10	
	Boys	Girls		Boys	Girls
10-12	36.9	38	0.6-0.7	5-10	5-10
13-15	15.3	49.9	0.6-0.7	9-18	12-24
16-19	62.9	54.4	0.5-0.6	5-9	14-28
Adult	Men	Women		Men	Women
Medium work	65	65	0.4-0.5	5-9	14-28
Pregnant (last trimester)			1.0-1.2		14-28
Breastfeeding (First 6 months)			1.0-1.2		

(Source: Report made by food and agricultural and world health organization committee).

Table No. 7 (b): Recommended amounts of minerals required by individuals of different age groups of Pakistan.

Age	Weight in kg	Calcium (mg)	Phosphorus (mg)	Iodine (IU)	Iron (mg)	Magnesium (mg)	Zinc (mg)
3 months	5-5	500	500	35	10	60	3
3-5 months	6-8	500	600	40	15	70	5
6-8 months	0-8	500	500	60	15	150	10
9-11 months	5-9	500	500	80	15	200	10
1 year	2-8	700	700	130	20	350	15
2 years	1-4	700	700	150	20	500	15
3 years	4-12	600	600	150	20	400	15
4 years	4-14	500	500	150	20	350	15
5 years	16-60	500	500	140	20	350	15

6 years	18.4	500	500	140	20	450	15
7 years	20.6	500	500	140	20	350	15
8 years	22.5	500	500	140	20	350	15
9 years	23.7	700	700	115	35	300	15
Boys							
10-12 year	35.0	700	700	115	35	300	15
13-15 year	48.0	600	600	100	30	300	15
16-19 year	58.0	500	500	100	30	300	15
Girls							
10-12 year	34.0	500	500	100	30	300	15
13-15 year	42.0	500	500	100	30	300	15
16-19 year	48.0	500	500	80	20	300	15

(Source: Report made by food and agricultural and world health organization committee).

1.6 DIFFERENT COMPONENTS OF DETERMINING TOTAL ENERGY NEEDS

You read about the different nutritional requirements of an individual. Now you must know about how to find out the daily energy requirements of a particular man or woman. For example, A man's daily needs would be as follows:

	Calories	Kilo joules
Energy required for BMR (24-Hours)	1680	7030
Changing clothes in one hour	33	138

Walking slowly for almost one hour	115	481
Slight exercise for 2 hours	170	711
Sitting for 4 hours	60	251
Sewing clothes for 8 hours	640	2675
Total	2698	11286

A hard-working man's needs would be as follow:

Energy required for BMR (24-Hours)	1680	7030
Walk for 1 hour	200	836
Rest for 8 hours	320	1338
Hard work-out for 8 hours	2560	10701
Total	4760	19905

Following are the ways to find out the total energy needs of a woman:

	Calories	Kilo joule
Energy required for BMR (24-Hours)	1440	6019
Light exercise for 3 hours	240	1003
household chores for 13 hours	429	1894
Total	2109	8916

Requirements of total energy need of pregnant women can be as follow:

	Calories	Kilo joules
Energy required for BMR (24-Hours)	1440	6019
Walking for one hour	200	836
Sitting for 2 hours	30	125

Domestic work for 13 hours	429	1894
Additional nutritional needs (pregnant woman)	400	1673
Total	2499	10547

Activity:

Find out the total needs of breastfeeding women with the help of above given examples by yourself.

Note: A breastfeeding woman requires more than 1000 additional calories per day.

1.6.1 Self-Assessment Questions

Fill in the following blanks by using appropriate words.

- 1- The vitamin and mineral requirements of a baby from birth to four months are fulfilled by _____.
- 2- Iron helps to make _____.
- 3- To fulfill the additional requirements of Calcium, pregnant and lactating women are advised to _____.
- 4- A pregnant or lactating woman requires total _____ calories.
- 5- Breastfeeding mothers require additional more than _____ calories per day.

Key for Self-Assessment

For answers refer below given sections

1. 3.1
2. 3.2
3. 3.3
4. 4
5. 4

Practical

Calculate the Basal Metabolic Rate (BMR) and total energy needs for a breastfeeding woman using the Harris-Benedict Equation and account for additional energy needs during lactation. Assume the woman has the following data:

- Weight: 70 kg
- Height: 170 cm
- Age: 28 years

UNIT 2

INFANT NUTRITION

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2.1. BREAST FEEDING

Breastfeeding offers the best nutrition for infants, along with significant non-nutritional advantages for both the child and the mother. Due to these benefits, the World Health Organization (WHO) and pediatric societies strongly recommend exclusive breastfeeding for approximately six months. In developed nations, it is generally advised to continue partial breastfeeding until the age of 12 months or even beyond.

2.1.1 Benefits of Breastfeeding

Breastfeeding benefits for the infant

1. The infant receives optimal nutrition from human milk due to its dynamic composition and nutritional balance.
2. As human milk and plasma have similar ion concentrations, it meets the infant's needs without the need for other nutrition or water.
3. Infectious diseases, such as diarrhea and respiratory tract infections, are protected by breastfeeding.
4. Human milk provides a balance of nutrients for growth and development in infants.
5. A large amount of lipids is found in human milk including essential fatty acids, saturated fatty acids, medium-chain triglycerides, and cholesterol.
6. Breast milk is largely protein-bound and balanced to meet infants' needs for minerals.
7. Human milk contains macrophages, neutrophils, T- and B-lymphocytes, and epithelial cells that protect infants from gastrointestinal tract infections, allergies, necrotizing enterocolitis, and tuberculosis.

2.1.2. Suggestions for Successful Breastfeeding

1. **Surround yourself with supportive and knowledgeable people.** This may include lactation consultants, healthcare professionals, and experienced mothers who can offer advice and encouragement when needed.
2. **Breastfeeding should be started as soon as possible after birth.**
3. **Breastfeed your baby whenever they show signs of hunger (rooting, sucking movements, or restlessness).** You should feed on demand to create a healthy milk supply.
4. Make sure the latch is correct to prevent nipple discomfort and promote effective milk transfer.
5. Find a breastfeeding position that is pleasant for both you and your baby.
6. To support your milk production, consume enough water and eat a healthy diet. Eating a variety of wholesome meals is crucial for your wellbeing.

7. Babies feed frequently in the first few weeks as they build up your milk supply. Before moving to the second breast, let your baby finish nursing on one until they appear satiated.
8. Introducing pacifiers or bottles too soon (usually during the first 4-6 weeks) might cause nipple confusion and undermine nursing relationships.
9. Breastfeeding can be tough, so put rest and self-care first. Accept aid from friends and family to lessen stress and fatigue.
10. It may take some practice to get the hang of breastfeeding, so be patient with both you and your baby. Both of you are learning as you go along.
11. Your child's growth will be monitored by your pediatrician during routine visits. Gaining weight steadily is a sign that your baby is receiving adequate milk.

2.1.3. Common Breast-Feeding Problems

- a) ***Letdown Failure:*** Letdown failure is rare, but letdown is essential for effective nursing.

Cause: Stress and drinking alcohol can cause letdown failure.

Management:

1. For letdown failure, a doctor may administer oxytocin nasal spray. To help women get through a difficult time, synthetic oxytocin is sprayed into the nose and induces letdown.
2. Play music that the nursing mother can concentrate on.
3. Go for a walk. Most infants like to walk.
4. Arrange for some time alone.
5. Reduce your intake of coffee and increase your water intake for a few weeks.

- b) ***Hyperactive Letdown:*** Hyperactive letdown is more common in first-time mothers. Milk starts to flow from the breast as feeding starts when the letdown is hyperactive. Milk may also leak from the breast that the baby is not nursing. The milk flows quickly, and the volume may be too much for the baby to handle. To keep up with the flow, the baby could choke, cough, or gulp. When a baby swallows, it may inhale air, experience gas pain, and then become unhappy.

Management:

1. Moving the baby away from the breast when there is a letdown and waiting for the milk flow to calm down before reintroducing the baby to the breast.
2. Until the milk flow slows, the mother can also express the milk.

c) **Sore Nipples:** Women starting to breastfeed frequently experience, mild nipple soreness. The discomfort is typically brief in women and goes away by the end of the first week. Nipple soreness that lasts during feeding, is severe, present in cracks or fissures, or does not subside by the end of the first week should not be taken for granted and needs to be evaluated.

Cause: Poor positioning of the infant at the breast, poor latch, improper release of suction after a feed, infection, pumping with too much suction, and an unorganized or dysfunctional suck are the main causes of persistent nipple pain.

Management:

1. Let breasts air-dry after nursing, apply expressed milk or an all-purpose cream (not one containing petroleum), and apply warm compresses to sensitive nipples.
2. If the mother's nipples are too painful to breastfeed, using a pump to express milk can help to maintain supply.

d) **Flat or Inverted Nipples:** Some women have nipples that are flat or inverted and don't extend very far into the mouth of the infant. If the latch is proper, breastfeeding shouldn't be affected by this. If the infant is having trouble latching, tell the mother to use a breast pump or rub her nipple between her fingers before feeding to draw the nipple out.

e) **Engorgement:** When breasts are overfilled with milk, engorgement results. This happens frequently to new mothers.

Cause: Engorgement happens when there is an abundance of milk, and the supply-and-demand cycle has not yet been formed. Ineffective or infrequent milk withdrawal from the breast due to mother-infant separation, a sleepy baby, sore nipples, or poor nursing technique can also cause it.

Management: Frequent nursing is recommended for management. (Newborn babies frequently nurse every 1.5 hours.) Expressing milk every few hours will help to increase and maintain a milk supply while preventing engorgement if the baby is unable to nurse.

f) **Plugged Duct:** A localized stoppage of milk caused by milk stasis (milk lingering in the ducts) is known as an obstructed, or "plugged," duct. The mother typically shows no other symptoms of disease, except for a painful knot in one breast.

Management: Complete emptying of the breast and gentle massage are the treatments for clogged ducts. Women might think about switching nursing positions to aid in breast emptying.

g) Mastitis: Breast inflammation known as mastitis is most frequently observed in nursing mothers. It might be contagious or not. About 3-20% of breastfeeding mothers experience it. Some women develop mastitis because of cracked or sore nipples, while others do not have any obvious surface issues with their breasts.

Cause: Missing a feeding or the baby napping all night long can cause engorgement, blocked ducts, and mastitis. Mastitis risk may also be increased by restrictions like a tight bra or outfit. In the breast, there is a reddened area that is frequently accompanied by a painful, hot, swollen, hard, wedge-shaped area. Mastitis cases frequently include fever and flu-like symptoms.

Management:

1. The most crucial mastitis care step is efficient milk removal.
2. If breastfeeding is uncomfortable, the mother should manually or mechanically express milk from the breast.
3. Ibuprofen is frequently recommended as a pain and inflammation reliever.
4. Proper nutrition, hydration, and rest are also essential.
5. Antibiotics should be used if symptoms do not get better within a day.

2.1.4. Breastfeeding of Preterm Infants

Breastfeeding is especially important for preterm infants because human milk appears to have a protective effect on the immature gut and reduces the risk of necrotizing enterocolitis. Preterm infants require more protein, which should be provided by fortifying the human milk in the proper way. If a mother is unable to breastfeed her child, donor milk should be considered. This could come from a human milk bank or from private donors. If donor milk is utilized, specific testing, storage, and pasteurization procedures must be followed.

2.1.5. Self-Assessment Questions

(a) Short questions:

- a) What are the benefits of breastfeeding for infants?
- b) What is the recommended duration for exclusive breastfeeding according to the WHO?
- c) What can be done to ensure a proper latch during breastfeeding?
- d) How can hyperactive letdown be managed during breastfeeding?
- e) Why is breastfeeding especially important for preterm infants?

(b) Multiple-Choice Questions

1. Which of the following is not a benefit of breastfeeding for infants? a) Optimal nutrition
- b) Protection against infectious diseases
- c) Delayed return of fertility
- d) Balance of nutrients for growth and development

2. **What is the recommended duration for exclusive breastfeeding by the World Health Organization (WHO)?**
- a) 3 months
 - b) 6 months
 - c) 9 months
 - d) 12 months
3. **What is a suggested way to support milk production during breastfeeding?**
- a) Avoid drinking water
 - b) Consume a variety of wholesome meals
 - c) Start introducing pacifiers within the first month
 - d) Limit breastfeeding to every 4-6 hours
4. **which of the following is a common breastfeeding problem characterized by milk stasis in the ducts?**
- a) Sore nipples
 - b) Letdown failure
 - c) Plugged duct
 - d) Hyperactive letdown
5. **Why is breastfeeding important for preterm infants?**
- a) It delays the return of fertility in mothers.
 - b) It provides infants with essential fatty acids.
 - c) It protects against necrotizing enterocolitis.
 - d) It helps mothers to bond with their babies.

Key for self-assessment questions

Short questions

- (a) Refer to 2.1.1
- (b) Refer to 2.1
- (c) Refer to 2.1.2
- (d) Refer to 2.1.3 (b)
- (e) Refer to 2.1.4

Multiple choice questions

- 1. (e)
- 2. (b)
- 3. (b)
- 4. (e)
- 5. (e)

2.2. BOTTLE FEEDING

Breastfeeding is by far the greatest nourishment for infants throughout their first six months of life, according to research. Unfortunately, nursing doesn't always succeed despite our best intentions, hopes, and attempts.

2.2.1 How to Bottle Feed Your Baby

1. Make sure your back is properly supported and that you are sitting pleasantly.
2. Check the temperature of the milk by dropping it on the inner part of your wrist.
3. Hold the bottle at an angle and make sure that the neck of the bottle is filled with milk to prevent your baby from sucking air.
4. Your baby may need a break or be full if he or she starts to turn away or get uneasy.
5. If you have twins or triplets, try to feed them one at a time whenever you can. This provides important individual time.

2.2.2. Infant Formula

Breastfeeding is the best choice for infant feeding and provides multiple benefits for children's health. Therefore, it is important to promote, safeguard, and support breastfeeding. Infant formula should be given to babies who cannot be breastfed, should not get breast milk, or for whom no breast milk is available. Infant formula must meet all an infant's nutritional requirements in a single meal item and offers a high intake per kilogram of body weight during a delicate stage of development. As a result, high quality and safety standards are applied to infant formulae.

2.2.3. Preparation, Storage, and Handling of Infant Formula

Powdered infant formula is sterile and may contain harmful bacteria like *Cronobacter* spp., which, sufficiently grown after the food is made, may cause invasive infections, especially in preterm and term newborns. Therefore, it is advised that powdered formula be made fresh for each feeding and fed no later than two hours following preparation. Formulas that have not been used should be thrown away. Strict hygiene requirements as well as documented instructions for the preparation and handling of formula should be followed by hospitals, nursery facilities and other organizations. Where possible and practical, the use of ready-to-feed liquid formula is recommended for newborns.

2.2.4. Self-Assessment Questions

Short questions

- a) How can you check the temperature of the milk before bottle-feeding?
- b) Why should the neck of the bottle be filled with milk during feeding?
- c) What precautions should be taken with powered infant formula?
- d) What is the primary reason for using infant formula instead of breastfeeding?

Key for self-assessment questions

Short questions

- | | |
|--------------------|--------------------|
| (a) Refer to 2.2.1 | (b) Refer to 2.2.1 |
| (c) Refer to 2.2.3 | (d) Refer to 2.2.2 |

Practical

Demonstrate the correct procedure for preparing powdered infant formula, including sterilizing equipment, measuring water and formula, mixing, and checking the temperature.

2.3. COMPLEMENTARY FEEDING

The WHO defines complementary foods as any meal or beverage other than breast milk. Complementary foods are necessary during 4-6 months of age, to facilitate the transition from milk feeding to family foods and for nutritional and developmental reasons. From a nutritional point of view, breast milk can no longer provide all a baby's macro- and micronutrient needs. From a developmental point of view, babies learn to chew and begin to show interest in meals other than milk, that's why complementary feeding is important.

2.3.1. Time to Start Complementary Feeding

The guidelines and practices for complementary feeding are typically not supported by research and differ between nations. Gastrointestinal and renal functions are likely to be sufficiently mature by around 4 months of age to enable infants to process some complementary foods. On the other hand, the age at which infants attain the necessary motor skills is likely to fall within the 4- to 6-month.

The WHO recommends that infants should be exclusively breastfed for 6 months before the introduction of complementary food. Exclusive breastfeeding for 6 months is desirable in situations where there is a lack of clean drinking water or safe nutritious complementary foods, there is less consensus regarding infants in higher-income settings. Although many countries have adopted the new WHO recommendation, other countries still recommend 4–6 months of breastfeeding.

2.3.2. Content of the Diet

Most current guidelines on the gradual introduction of different foods during complementary feeding are based on cultural factors and food availability rather than scientific evidence. Recommendations are based on the concept that breast milk cannot meet the full requirements for energy, protein, and micronutrients beyond about 4-6 months of age.

a) *Energy:* Energy requirements remain high during the first year of life. Dietary fat should make up at least 25% of total calories consumed because it plays a significant role in determining the diet's energy density. If the baby has a poor appetite, recurrent illnesses, or is fed infrequently, a higher proportion can be necessary.

b) *Iron and Zinc:* Complementary foods provide more than 90% of the infant's iron needs who are breastfed. Use of fortified weaning foods, iron-enriched

newborn formulae, and foods high in bio-available iron, such as meat, are some methods for ensuring appropriate intakes of iron and zinc.

c) ***Salt and Sugar:*** Infants that consume a lot of salt may later have greater blood pressure. Additionally, babies may become adapted to a salty taste, which may influence their future dietary preferences. Therefore, salt shouldn't be added to dishes that go well together. Dental caries is linked to the consumption of sugar. Its usage must be strictly restricted, and kids need to learn healthy dental hygiene habits early on.

d) ***Allergy:*** Eggs, fish, almonds, and seafood are some of the foods that may cause allergies. The data, however, is not strong enough to support the claim that postponing the introduction of such foods lowers the likelihood of developing food allergies. If foods are offered before the child is 3–4 months old, allergy risk may rise. Additionally, eliminating fish and eggs from the diet may have negative nutritional effects.

2.3.3. Guides to Complementary Feeding

For the introduction of complementary foods and for the progression through the second year of life, the following guiding principles are offered.

1. ***One “single food”*** new food should be introduced at a time. Do not introduce additional foods from any food group for a few days to watch any potential allergic responses or food intolerances.
2. ***Introduce a range of foods:*** Infants should be eating from all food groups by the time they are 7 to 8 months old.
3. ***Select foods with essential elements:*** For mainly breastfed newborns, iron and zinc become limiting micronutrients. Iron- and zinc-fortified baby cereals and meats are great first foods.
4. ***Minimize juice consumption:*** Juice should not be given to infants under the age of six months, and it is recommended to wait until they are at least 12 months old.
5. ***Refrain from giving infants any plant-based “milk”:*** Fresh cow milk is not advised since it has been linked to low-grade intestinal blood loss in babies. It is not recommended to substitute human milk or infant formula with liquids labeled as “milk,” such as those made from plant foods like soy, rice, and almonds.
6. ***Ensure that supplementary foods are prepared safely:*** Many families find it convenient to prepare pureed or mashed table foods at home.
7. ***Promote regular mealtimes:*** Establish routines for meals and snacks on a predictable schedule, often allowing 2 to 3 hours between eating and drinking, resulting in 5 to 6 meals or snacks per day (e.g., 3 meals, 2-3 snacks).
8. ***Limit distractions*** (TV, videos, cell phones, other screens, dogs, etc.) during mealtimes.

9. **Encourage babies to use their fingers:** By the age of nine months, babies should be given finger foods, and an open cup may be introduced.

2.3.4. Month Wise Introduction of Complementary Feeding

Age	Foods to Introduce
From birth to 6 months	Exclusive breast feeding
After 6 months	Single grain cereals (rice, wheat), Pureed fruits (banana), vegetables (mashed potatoes), pureed chicken, beef + mother feed
6-8 months	Strained or mashed fruits (apple, peach, mango), vegetables (carrots, green beans, broccoli) Yogurt, Soft, cooked mashed eggs, butters + mother feed
8-12 months	Small pieces of soft fruits and vegetables, cooked and finely chopped meats, fish, egg, cooked chapatti or rice, soft bread or biscuits, cooked beans, and lentils. Formula milk/ Whole milk (can be introduced as a main drink, after consulting a pediatrician) + mother feed
+12 months	Soft and diced fruits and vegetables, bite sized portions of meats, fish, poultry and egg, chapatti, Nuts and seeds, honey, formula milk/ Whole milk (can be introduced as a main drink, after consulting a pediatrician) + mother feed

2.3.5. Self-Assessment Questions

1. Short questions

- At what age are infants typically ready to process some complementary foods?
- Why is exclusive breastfeeding for 6 months desirable in certain situations?
- What are some essential elements that should be included in complementary foods?
- Why should infants not be given plant-based “milk” substitutes?

2. True/false statements:

- Complementary foods are necessary during 4-6 months of age for /False) nutritional and developmental reasons.
- Breast milk can fully meet a baby’s macro-, and micronutrient needs /False) beyond about 4-6 months of age.
- Salt and sugar should be added to dishes to make them tastier for /False) infants.
- Allergy risk may increase if foods like eggs and fish are introduced /False) before the child is 3-4 months old.
- It is recommended to introduce finger foods and an open cup to /False) babies by the age of six months.

Key for self-assessment questions

Short questions

- (a) Refer to 2.3.1
- (b) 2.3.1
- (c) 2.3.2
- (d) 2.3.3

True/False

- (a) True
- (b) False
- (c) False
- (d) True
- (e) False

Practical

1. Demonstrate the preparation of a vegetable puree and a mashed fruit. Record each step on your worksheet and discuss the nutritional benefits of each food.
2. Create a one-week meal plan that includes a variety of complementary foods. Ensure the plan provides balanced nutrition and introduce foods from different food groups.

2.4 COMPLEMENTARY FEED PREPARATION AT THE HOUSEHOLD LEVEL (RECIPES)

Starting with complementary or first foods is a time for trying a range of new flavors and textures. Your baby will be eating the same healthy meals as the family by 12 months of age. At younger ages, it is easiest to take part of your family meal and change its texture to suit their development (e.g., a roast for the rest of the family could become pureed vegetables and meat blended with meat juices for baby). Expressed breastmilk, infant formula or cow's milk may be used to help puree, mash, or blend food. Avoid adding salt, sugar, or honey to foods. Try making your own recipes as you become more confident feeding your baby. Here are some to help you get started.

2.4.1. Pureed Vegetables

Sr. #	Ingredients	Quantity
1	Potato	1 small
2	Carrot	½ cup grated
3	Green leafy vegetable (broccoli, zucchini, lettuce)	1 small piece
4	Water	½ cup

Recipe:

1. Chop all vegetables finely.

2. Using a steamer or saucepan, bring a small amount of water to the boil.
3. Add the vegetables, cover with a tight-fitting lid, and cook quickly until vegetables are soft.
4. Press vegetables through a strainer or puree in a blender or food processor.

2.4.2 Pureed Fruit (Fresh Apple, Pear, Peach, Apricot, Mango Stones Removed)

S.#	Ingredients	Quantity
1	Fresh apple	1 peeled
2	Water	1 cup

Recipe:

1. If using fresh fruit: wash, peel, and dice it.
2. If using dried fruit: wash and dice it, then soak it in just enough water to cover it for at least 15 minutes before cooking.
3. Place fresh fruit or soaked dried fruit and any remaining liquid in a saucepan.
4. Add just enough water to cover the bottom of the saucepan and cook quickly until the fruit is soft.
5. Press pulp through a strainer or puree in a blender.

2.4.3 Pureed Meat with Potato

S.#	Ingredients	Quantity
1	Lean meat (e.g. chicken, beef)	3 tablespoons/ ¼ cup finely chopped/minced
2	Potato	1 /2 cup peeled
3	Water	1 cups

Recipe:

1. Place meat and sweet potato in a saucepan with enough water to cover.
2. Simmer gently until tender and well-cooked.
3. Press through a sieve or blend to a smooth consistency.

2.4.4 Baked Egg Custard

S.#	Ingredients	Quantity
1	Egg	1
2	Milk (breastmilk/formula/milk)	1 small cup/150 ml
3	Vanilla essence	½ teaspoon
4	Pureed fruit	1 tablespoon

Recipe:

1. Beat egg, milk, and vanilla together.
2. Pour into an ovenproof dish (about the size of 1 cup/250mL).

- Stand in a baking dish containing enough water to come halfway up the side of the ovenproof dish.
- Bake at 180°C for about 25 to 30 minutes or until set.
- Serve warm or cold with pureed fruit.

2.4.5 Porridge (Wheat, Oat)

S.#	Ingredients	Quantity
1	Wheat porridge	2 tablespoons
2	Milk	1 cup/ 250 ml
3	Oil/Ghee	1 tablespoon
4	Water	2 cups

Recipe:

- Over a gentle heat cook porridge in oil until light brown.
- Add water and cover with a lid and cook on low flame.
- A semi-solid form will be ready for feeding the infant.

2.4.6 Sooji ka Halwa (Semolina)

S.#	Ingredients	Quantity
1	Sooji (Semolina)	4 tablespoons/ ¼ cup
2	Water	1 cup/ 250 ml
3	Oil/Ghee	1 tablespoon

Recipe:

- In a frying pan cook sooji with oil on a gentle heat for a few minutes for color change.
- Add water and cook for 10-15 minutes.
- Remove from heat when water evaporates, and the required consistency is achieved.

2.4.7 Banana Rice Pudding

S.#	Ingredients	Quantity
1	Rice (cooked)	¾ cup / 12 tablespoons
2	Banana	Half
3	Milk (expressed breast milk, formula milk)	¾ cup (180 ml)

Recipe:

- Mix the cooked rice, milk, and banana.
- Heat in a saucepan over low heat until milk is absorbed, stirring frequently

2.4.8 Minced Stew

S.#	Ingredients	Quantity
1	Onion (chopped)	¼
2	Carrot (diced)	1/2
3	Mince	¼ cup

Recipe:

1. Sauté onion in a little vegetable oil.
2. When the onion is soft, add in carrot and stir.
3. When the vegetables have slightly softened, add mince and brown it.
4. Add a little water if needed. This will also help break up the mince and form a sauce.

2.4.9 Kitchri (Daal Mong, Massor)

S. No.	Ingredients	Quantity
1	Rice	1 cup
2	Daal	¼ cup (4 tablespoons)
3	Oil/ghee	1 Tablespoon
4	Water	2 cups

Recipe:

1. Add rice, daal, and water to a cooking pan.
2. Cook on low flame until soft.
3. Add oil and mix. Puree form is ready to eat.

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UNIT 3

EFFECT OF COOKING ON THE NUTRIENT CONTENT OF FOOD

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3.1 INTRODUCTION

Vitamins, minerals, proteins, lipids, and carbohydrates are just a few examples of the nutrients that are necessary to sustain good health and wellbeing. They act as the building blocks for the body's development, synthesis of energy, and numerous biochemical processes. The delicate nature of these necessary components, however, make them viable for leaching, denaturation, and other types of deterioration during cooking. Some cooking techniques could increase the availability of nutrients, others might result in nutrient losses. The dynamic changes in nutrient levels are a result of the interaction of several variables, including cooking time, temperature, water exposure, and the type of food being processed.

Understanding different cooking methods and how they affect nutrient retention can help us make educated decisions about our culinary practices and ensure that we get the most nutritional value possible from the foods we eat.

3.2 OBJECTIVES

The students will be able to:

1. Describe the advantages of cooking food by the end of this unit.
2. Explain the function of cooking in relation to various food classes, such as meat, pulses, grains, etc.
3. Talk about ways to avoid nutritional loss during cooking.
4. Describe food preservation techniques and their benefits and drawbacks.

3.3 COOKING AND ITS BENEFITS

Food preparation using heat, or a variety of cooking methods is known as cooking. It is art, science, and craft. It entails converting uncooked foods, including fruits, vegetables, meats, grains, and other culinary products, into delectable dishes. Cooking is done to make food more appetizing and easily digestible by improving the taste, texture, aroma, and nutritional content of the ingredients.

Sometimes you have noticed that the animals and other living beings eat raw food. Human beings also eat certain foods like fruits and vegetables in the uncooked form. But certain foods cannot be eaten in raw form due to the following reason:

The uneatable and the non-nutritive substances are separated from the food stuffs through the processing and preparation. At the household level it is called preparation while at the industrial level it is known as processing. Raw foods are not tasty; cooking makes the food tasty and eatable. It is easy to digest cooked food.

3.3.1 Effect of Cooking on Nutrition of the Food

Cooking can have both positive and negative effects on the nutrition of food, depending on the cooking method used and the type of food being cooked. Here are some of the effects of cooking on the nutrition of food:

1. *Increases bioavailability of nutrients*

Cooking can break down the cell walls of plants and animal tissues, making the nutrients more accessible and easier to digest. For example, cooking tomatoes can increase the bioavailability of lycopene, a potent antioxidant that can help prevent cancer.

2. *Destroys some nutrients.*

Some nutrients, such as vitamin c and b vitamins, are sensitive to heat and can be destroyed during cooking. For example, boiling vegetables for long periods of time can lead to significant losses of vitamin c.

3. *Decreases anti-nutrients.*

Some foods contain anti-nutrients, such as phytic acid, that can inhibit the absorption of certain minerals. Cooking can help to reduce the levels of anti-nutrients and increase the bioavailability of minerals.

4. *Increases the glycemic index.*

Cooking certain foods, especially carbohydrates, can increase the glycemic index (GI) of the food. GI is a measure of how quickly a food raises blood sugar levels, and high-GI foods have been linked to an increased risk of obesity and type 2 diabetes.

5. *Creates harmful compounds.*

Cooking at high temperatures, such as grilling or frying, can produce harmful compounds like acrylamide, heterocyclic amines (HCAs), and polycyclic aromatic hydrocarbons (PAHS) that have been linked to cancer.

Overall, cooking can have both positive and negative effects on the nutrition of food. To maximize the benefits of cooking, it is important to use cooking methods that preserve the nutrients in the food while minimizing the formation of harmful compounds."

3.3.2 Effect of Cooking on Meat

Meat is a perishable commodity. It gets deteriorated especially in the humid environment i.e., monsoon. So, it is essential to cook meat properly to kill the microorganisms. If some of the microorganisms remain on the food, the acidic conditions of the stomach kill them. The traditional cooking techniques kill most of the microorganism. In the European countries, underdone meat usually causes food poisoning.

Cooking meat properly is essential for several reasons:

1. ***Kills harmful bacteria:*** raw meat may contain harmful bacteria such as salmonella, e. coli, and campylobacter. Cooking meat at a high enough temperature will kill these bacteria and make the meat safe to eat.
2. ***Prevents foodborne illnesses:*** eating undercooked or raw meat can cause foodborne illnesses, which can lead to symptoms such as nausea, vomiting, diarrhea, fever, and abdominal cramps. In severe cases, foodborne illnesses can be life-threatening.
3. ***Improves digestibility:*** cooking meat breaks down its proteins and makes it easier for our bodies to digest. This also makes the meat more flavorful and tender.
4. ***Enhances nutritional value:*** cooking meat can increase the availability of certain nutrients, such as protein and iron, making it more nutritious and beneficial for our bodies.
5. ***Enhances taste and texture:*** properly cooked meat is more flavorful and has a better texture than raw or undercooked meat.

Overall, cooking meat properly is important for both safety and taste reasons. It's essential to follow cooking guidelines and use a food thermometer to ensure that meat is cooked to a safe temperature."

3.3.3 Self-Assessment Questions

Question for review

1. Why do we need to cook the food?

2. List the harmful substances produced during cooking.
3. Cooking can have both positive and negative effects on the nutrition of food. Explain.
4. Meat is a perishable commodity. Why cooking meat is an essential process? Explain.
5. Why is boiling not recommended for cooking vegetables?

Key for self-assessment questions

1. Refer to heading 3.3
2. Refer to 3.3.1 (sub-heading 5)
3. Refer to 3.3.1
4. Refer to 3.3.2
5. Refer to 3.3.1 (sub-heading 2)

Practical

What are the differences in texture, flavor, and appearance of vegetables prepared by boiling, steaming, and grilling? After cooking, observe and taste the vegetables. Record your observations on texture, flavor, and appearance on your worksheet.

3.4 EFFECT OF COOKING ON THE CEREAL

Cooking can have a significant effect on cereal, both in terms of its texture and nutritional content.

3.4.1 Texture

When cereal is cooked, it absorbs water and softens, which can make it easier to digest and more palatable. Cooking can also enhance the flavor of some cereals.

3.4.2 Nutrition

Cooking can both increase and decrease the nutritional value of cereal, depending on the type of cereal and the cooking method used. For example: cooking can increase the bioavailability of some nutrients, making them easier for the body to absorb. For example, cooking can break down the starch in grains, making the carbohydrates more available for digestion.

On the other hand, cooking can also destroy some nutrients. For example, vitamin c is sensitive to heat and can be destroyed during cooking. Overcooking can also lead to the loss of some nutrients, especially water-soluble vitamins like b vitamins.

Overall, the effect of cooking on cereal depends on the type of cereal and the cooking method used. In general, cooking can enhance the texture and flavor of cereal, but it is important to be aware of the potential impact on its nutritional value.

3.4.3 Self-Assessment Question

Question for review

Q1. What is the role of cooking cereals? Explain in the term of:

- a. Texture
- b. Nutrition

Key for self-assessment questions

Q1. Refer to 3.4.1 for part a and 3.4.2 for part b.

3.5 EFFECT OF COOKING ON PULSES AND BEANS

Cooking has several effects on pulses and beans, including:

1. **Softening:** pulses and beans contain complex carbohydrates, which can be difficult to digest when they are raw. Cooking breaks down these complex carbohydrates and makes them easier to digest.
2. **Increased nutrient availability:** cooking pulses and beans can increase the availability of certain nutrients, such as protein and minerals, by breaking down anti-nutrients that can inhibit their absorption.
3. **Improved flavor:** cooking pulses and beans can improve their flavor and make them more palatable. This is especially true if they are cooked with seasonings and spices.
4. **Reduced anti-nutrient content:** some pulses and beans contain anti-nutrients such as phytic acid and lectins that can reduce the absorption of certain nutrients. Cooking can reduce the content of these anti-nutrients.
5. **Decreased cooking time:** soaking pulses and beans prior to cooking can help to reduce cooking time, making them more convenient to prepare.

It is important to note that overcooking can lead to the loss of some nutrients, so it is important to cook pulses and beans until they are tender but not mushy."

3.5.1 Effect of Preparatory Operation and Milling of Cereals on their Nutritional Content

Preparatory operations and milling of cereals can have a significant impact on their nutritional content. Some of the effects are as follows:

1. **Loss of fiber:** cereals contain a significant amount of dietary fiber, which is essential for maintaining gut health and reducing the risk of chronic diseases. However, during the milling process, the outer layer of the grain (bran) is removed, which results in a significant loss of fiber.
2. **Loss of vitamins:** cereals are a good source of several vitamins, including thiamin, riboflavin, niacin, and vitamin b6. However, the milling process can result

in the loss of these vitamins, especially thiamin, which is concentrated in the outer layers of the grain.

3. **Loss of minerals:** cereals are also a good source of minerals, including iron, magnesium, and zinc. However, the milling process can result in the loss of these minerals, as they are concentrated in the bran and germ of the grain, which are removed during milling.

4. **Reduced antioxidants:** cereals also contain antioxidants such as phenolic compounds, which have been shown to have numerous health benefits. However, the milling process can result in a significant reduction in these compounds.

In summary, preparatory operations and milling of cereals can result in a significant loss of fiber, vitamins, minerals, and antioxidants. It is therefore recommended to consume whole grains, which contain all parts of the grain, including the bran and germ, to obtain maximum nutritional benefits.

3.5.2 Structure of Seed

The structure of a seed varies depending on the type of plant it belongs to, but most seeds have three main parts:

1. Seed coat,
2. Endosperm, and
3. Embryo.

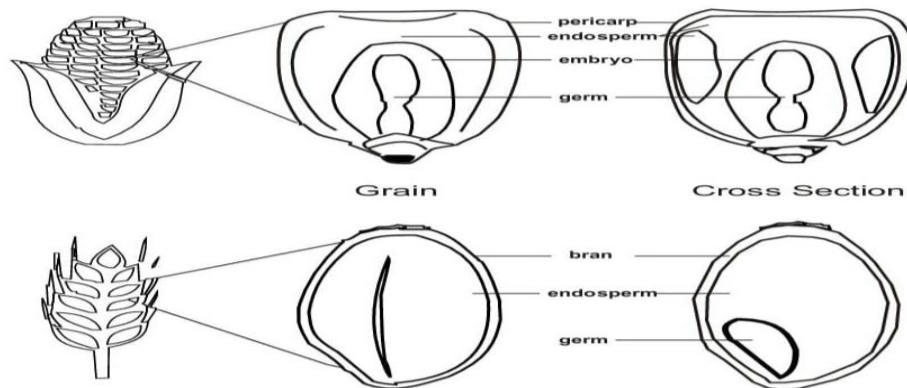


Figure 1: Structure of Seed

Figure 1: Structure of Seed

1. **Seed coat:** the seed coat is the outer layer of the seed that protects it from physical damage, water loss, and disease. It is composed of a tough, protective layer of cells that are often colored and textured to aid in dispersal by wind, water, or animals.

2. **Endosperm:** the endosperm is a tissue that surrounds the embryo and provides the initial source of nutrition for the developing plant. It is usually composed of starchy or oily cells that are rich in carbohydrates, proteins, and other nutrients.

3. **Embryo:** the embryo is the miniature plant that is contained within the seed. It consists of a small shoot (plumule) that will grow into the stem and leaves of the plant, and a small root (radicle) that will grow into the roots of the plant. The embryo also contains a small amount of stored food, usually in the form of starch, to provide energy for the initial stages of growth.

In some seeds, such as those of legumes (e.g., beans, peas), there is also a special tissue called the cotyledon, which serves as a nutrient storage organ for the developing plant. In these seeds, the cotyledon is often the primary source of food for the embryo, rather than the endosperm."

3.5.3 Self-Assessment Questions

Question for review

- Q1. How does preparatory operation and milling affect the nutritional content of cereals?
- Q2. What is the effect of cooking on the pulses and beans?
- Q3. Enlist different parts of seed.
- Q4. Label the following picture:

Key for self-assessment questions

- 1. Refer to 3.5.1
- 2. Refer to 3.5
- 3. Refer to 3.5.2
- 4. Refer to figure 1

Practical

Observe and describe the seed coat, embryo, and endosperm of the dissected seed. Draw a labeled diagram of the seed's internal structure

3.6 EFFECT OF MILLING PROCESS ON RICE

"Milling is a process of removing the outer layers of the rice grain, which includes the husk, bran, and germ, to produce polished or white rice. This process has several effects on rice:

1. **Nutrient loss:** milling removes the outer layers of the rice grain that contain most of its nutrients, including fiber, vitamins, minerals, and antioxidants. As a result, polished rice is less nutritious than brown rice, which retains these nutrients.
2. **Shelf life:** milling extends the shelf life of rice by removing the bran and germ, which contain oils that can become rancid and cause the rice to spoil.
3. **Appearance:** milling gives rice a uniform, polished appearance that is preferred by some consumers.
4. **Cooking properties:** milling affects the cooking properties of rice by removing the outer layers, which can make the rice cook faster and absorb more water.
5. **Taste and texture:** milling can affect the taste and texture of rice. Some people prefer the nutty flavor and chewy texture of brown rice, while others prefer the milder flavor and softer texture of polished rice.

Overall, milling has both positive and negative effects on rice. While it extends the shelf life of rice and gives it a polished appearance, it also removes most of its nutrients and can affect its taste and texture."

3.6.1 Self-Assessment Questions

Question for review

- Q1. Explain the effect of milling process on rice.

Key for self-assessment questions

1. Refer to 3.6

3.7 EFFECT OF BOILING ON THE NUTRITIONAL CONTENT OF FOOD

"Boiling is a common cooking method that involves heating food in water or other liquids until it reaches a boiling point. This cooking method can have both positive and negative effects on the nutritional value of food. It also alters the flavor and texture of the food. On the other hand, it also produces harmful substances as well.

3.7.1 Positive Effects

Boiling can help to retain some of the nutrients in food, especially when it is done for a short period of time. For example, boiling vegetables for a few minutes can help to preserve some of their vitamins and minerals.

3.7.2 Negative Effects

Boiling for a long period of time or with excessive water can

Lead to nutrient loss.

Water-soluble vitamins such as vitamin c and some b vitamins are particularly vulnerable to loss through boiling.

Additionally, minerals like potassium and calcium can be lost if they dissolve in the cooking water and are not consumed.

Boiling can also affect the flavor and texture of food. Overcooking can cause food to become mushy or flavorless, while undercooking can leave it tough and unappetizing.

Boiling can also lead to the formation of harmful compounds, such as acrylamide in starchy foods like potatoes or rice, which can be carcinogenic.

In conclusion, boiling can have both positive and negative effects on the nutritional value of food. While it can help to retain some nutrients, it can also lead to nutrient loss, especially when done for a long time or with excessive water. It is important to use the appropriate amount of water and cooking time to ensure that food retains its nutritional value and remains flavorful and appetizing."

3.7.3 Ways to Reduce Nutritional Loss During Cooking

There are several ways to reduce nutritional loss during cooking:

1. ***Use minimal water:*** when cooking vegetables, use just enough water to cover them. This can help to preserve their nutrients and prevent them from leaching into the cooking water.
2. ***Cook at lower temperatures:*** cooking at high temperatures for extended periods of time can lead to nutrient loss. Instead, cook food at lower temperatures for shorter periods of time to minimize nutrient loss.
3. ***Steam instead of boiling:*** steaming is a cooking method that involves cooking food with steam instead of boiling water. This can help to retain nutrients and prevent them from leaching into the cooking water.
4. ***Microwave instead of boiling:*** microwaving is a quick and efficient way to cook food that can help to preserve nutrients. It requires minimal water and can cook food in a shorter period than boiling.
5. ***Cut food into smaller pieces:*** cutting food into smaller pieces before cooking can help to reduce cooking time and minimize nutrient loss.
6. ***Use the cooking water:*** if you do boil food, try to use the cooking water in soups or sauces to retain some of the nutrients that have leached into the water.
7. ***Use a lid:*** covering food with a lid while cooking can help to trap steam and prevent nutrient loss.

In summary, there are several ways to reduce nutritional loss during cooking, such as using minimal water, cooking at lower temperatures, steaming instead of boiling,

microwaving instead of boiling, cutting food into smaller pieces, using the cooking water, and using a lid."

3.7.4 Self-Assessment Questions

Question for review

- Q1. Is boiling an efficient way of cooking? Discuss.
- Q2. How can you reduce nutritional loss during cooking?

Key for self-assessment questions

- 1. Refer to 3.7. 3.7.1 and 3.7.2
- 2. Refer to 3.7.3

Practical

Compare the appearance, texture, and taste of the boiled vegetables with their raw counterparts.

Note any changes in color, texture, or taste.

3.8 STORING AND THE PRESERVATION OF FOOD

Food preservation and storage are crucial techniques that maintain the quality, safety, and lifespan of perishable goods while minimizing food waste and assuring a consistent food supply. The nutritional value of food may be preserved, harmful bacteria's development is reduced, and rotting is prevented by using the right storage and preservation methods. Storing and preserving food can have several advantages and disadvantages:

3.8.1 Advantages

- 1. ***Reduces food waste:*** proper storage and preservation can help to reduce food waste by extending the shelf life of perishable food items.
- 2. ***Convenient:*** storing and preserving food can make it more convenient to have food available when needed, especially when fresh food is not readily available.
- 3. ***Saves money:*** by reducing food waste, proper storage and preservation can also save money by preventing the need to buy new food items frequently.
- 4. ***Improves food safety:*** proper storage and preservation can also improve food safety by preventing the growth of bacteria, mold, and other harmful microorganisms that can cause foodborne illnesses.

3.8.2 Disadvantages

1. ***Can alter taste and texture:*** some storage and preservation methods, such as freezing or canning, can alter the taste and texture of food.
2. ***Nutrient loss:*** some preservation methods, such as canning, can cause nutrient loss in food.
3. ***Chemicals and additives:*** some preservation methods, such as using preservatives, can involve the use of chemicals and additives that may not be desirable for some people.
4. ***Energy consumption:*** some preservation methods, such as freezing, require energy consumption, which can increase utility bills and have an environmental impact.
5. ***Equipment needed:*** some preservation methods, such as canning or dehydrating, require specialized equipment, which can be costly.

In conclusion, storing and preserving food can have several advantages, including reducing food waste, improving food safety, and saving money. However, there are also some disadvantages, such as altered taste and texture, nutrient loss, the use of chemicals and additives, energy consumption, and the need for specialized equipment."

3.8.3 Self-Assessment Questions

Question for review

- Q1. What are the advantages of storing and preserving the food?
- Q2. What are the disadvantages of storing and preserving the food?

Key for self-assessment questions

1. Refer to 3.8.1
2. Refer to 3.8.2

Practical

Choose perishable items (e.g., milk, cheese, fresh vegetables). Place them in the refrigerator at the appropriate temperature (below 40°F or 4°C). Label and date each item. Note the physical changes occurred in the products placed in the refrigerators.

3.9 FOOD FORTIFICATION

3.9.1 Introduction

"Food fortification is the process of adding vitamins, minerals, and other nutrients

to food to increase its nutritional value. It is done to address micronutrient deficiencies, which are widespread in many parts of the world.

3.9.2 Food Fortification Benefits

Food fortification has several benefits:

1. **Improved nutrition:** fortified foods can provide additional nutrients that may be lacking in a person's diet. This can help to improve overall nutrition and prevent micronutrient deficiencies.
2. **Cost-effective:** food fortification is a cost-effective way to deliver nutrients to a large population, particularly in low-income areas where access to nutrient-rich foods is limited.
3. **Safe:** the fortification process is carefully regulated to ensure that the added nutrients are safe and do not cause any adverse health effects.
4. **No change in taste or appearance:** fortified foods do not usually have any significant change in taste or appearance, making them more acceptable to consumers.
5. **Reduces health risks:** fortified foods can help to reduce the risk of several health problems, such as anemia, neural tube defects, and osteoporosis.
6. **Suitable for all age groups:** fortified foods can be consumed by people of all ages, including children, pregnant women, and the elderly.
7. **Easy to implement** fortification can be easily integrated into existing food production systems and does not require major changes in eating habits or food preferences.

Do you Know ?

Fortification adds additional micronutrients to a food product that were not present (or present in very small amounts) before to processing, whereas **food enrichment** restores micronutrients to a food product that were lost during processing.

In conclusion, food fortification is a simple, cost-effective, and safe way to improve the nutritional quality of food and reduce micronutrient deficiencies. It has several benefits, including improved nutrition, reduced health risks, and suitability for all age groups."

3.9.3 Self-Assessment Questions

Question for review

- Q1. Define food fortification.
- Q2. What are the benefits of food fortification?
- Q3. Differentiate between food fortification and enrichment.

Key for self-assessment questions

- Q1 Refer to 3.9.1
- Q2 Refer to 3.9.2
- Q3 Refer to the information given in the box.

UNIT 4

FOOD MICRO ORGANISMS ADVANTAGES AND DISADVANTAGES

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4.1 INTRODUCTION

Food microorganisms, often referred to as food microbes, are tiny living organisms that play a significant role in the world of food. These microorganisms can include bacteria, yeast, Molds, and viruses. They are found in diverse types of foods and can have both positive and negative effects.

On the positive side, certain food microbes are used intentionally in food production processes. For example, yeast is used to ferment bread and brew beer, while bacteria are used to create yogurt, cheese, and sauerkraut. These microorganisms contribute to the flavour, texture, and preservation of these foods.

However, some food microbes can be harmful and lead to food borne illnesses if food is not managed, prepared, or stored properly. Preventing the growth of harmful microbes is crucial in ensuring food safety.

Understanding the role of food microorganisms is essential for food scientists, producers, and consumers alike, as it impacts the quality, safety, and nutritional value of the foods we consume.

4.2 OBJECTIVES

After reading this unit, you will be able to

1. Understand tiny creatures such as microbes.
2. Learn techniques for preventing harmful microbes.
3. Discover nutritious foods and incorporate them into your dietary habits.

4.3 VIRUS

Virus is a Latin word that literally means poison. It was first discovered by a Russian scientist Wan sky in 1892. If a virus enters the human body (host), it takes control of the cell's machinery and starts making the compounds it needs for its growth. Host cells start working for the virus instead of working for the human body. In response, the virus releases toxin into the cell. This poison/toxin not only inflicts significant harm on the human body but also leads to fatal diseases that are challenging to eradicate.

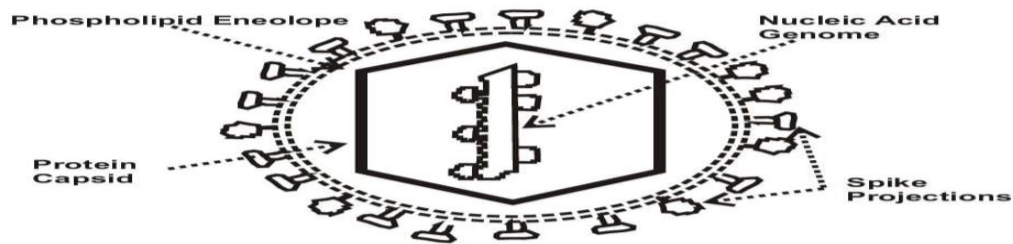


Fig 4.1

4.3.1 Structure

It is a parasitic organism that contains either RNA or DNA. DNA/RNA found in the nucleus of the cell (**Figure 4.1**). It is the substance through which inheritance is passed from mother cell to daughter cell during reproduction. It is responsible for all the activities of the cell. Viruses can reproduce only inside living organisms. It affects specific organs of the body. A virus is a very small organism that can be seen with the help of an electron-microscope. This microscope is a combination of several lenses. Electron microscope is more powerful as compared to normal microscope.

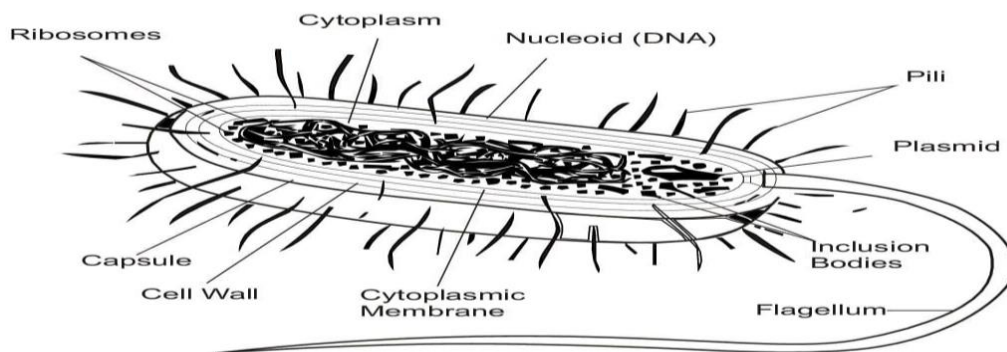


Fig4.3 Bacteria Cell

4.3.2 Types

The structure of the virus generally is grouped as De-oxy-virus or DNA virus and Ribo virus or RNA virus.

- 1) DNA viruses include Pox virus and Bacteriophage which eats bacteria.
- 2) RNA virus includes Enter Virus, Ribo virus and foot & Mouth disease virus and numerous other viruses.

Apart from them, there are different groups. Viruses of the nervous system (Neurotropic), skin viruses (Dermo trophic) and Glandular virus.

4.3.3 Morphology

A virus is also called a virion, a virus has the following forms:

1. Round Spherical Influenza Virus
2. Stranded Helical Rabies virus.
3. Cube-shaped Cub Smallpox virus
4. Rod shaped Tobacco-Mosaic Virus

Viruses vary in size and shape. The smallest virus is foot and mouth disease virus its size is about 20 to 30 milli microns. The size of Animal smallpox is about 300 to 450 milli microns.

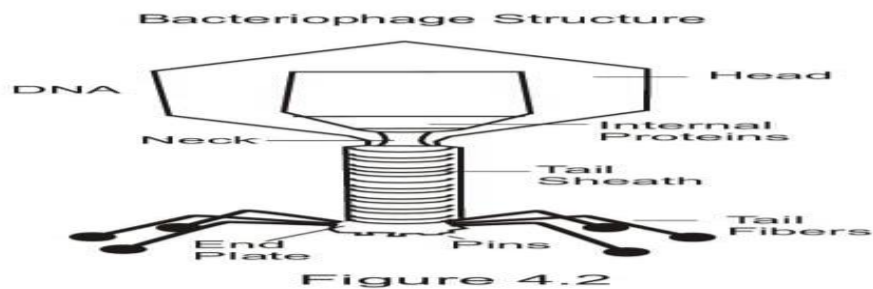
4.3.4 Food of Virus

Viruses only survive in living organisms they obtain their diet from them. At which cell the virus attack they obtain enzyme and protein from them and with the help of cells they utilize protein as diet.

4.3.5 Breeding

Virus reproduction is always intracellular. Bacteriophage has been used experimentally for the study of growth of viruses. These viruses are bacteria; you will read further in this unit.

Bacteriophage as you can see in Figure 4.2 looks like a Tadpole. Its head adheres to the outer surface of bacteria. The tail shrinks and pours its contents through the bacterial cell into the cytoplasm. This viral material forces the bacterial machinery,



the mini nucleus, to make the molecules it needs. The core material of the bacteria stops working for itself and begins to produce the protein which is used by virus's DNA. After utilizing host proteins, a single virus undergoes replication to produce multiple copies of its genetic material (DNA or RNA), and these genetic copies assemble to form a new generation of the virus. After that this bacterium died and then these tiny viruses attack to other bacteria. A single virus can multiply into 200 viruses within 20 to 60 minutes.

4.3.6 Inoculation Period

“The host virus and bacteria remain in an incubation state for some time after entering the host. The period before symptoms appear is called the negative period or incubation period. During this period, the germs increase their numbers, and produce poison in the human body. During this period, the patient doesn't feel any symptoms. The incubation period of every virus is different.

4.3.7 Motility

Viruses are generally considered non-motile, meaning they do not have the ability to move or exhibit self-propelled motion on their own.

Viral diseases spread by following ways:

1. **Directly:** Germs are contagious and infect a healthy person directly, as is the case with sexually transmitted diseases and if infected person gets in contact with a healthy person, a healthy person can also be infected.
2. **Through the air:** Particles smaller than five microns come out from lungs through sneezing and coughing; causes influenza, poliomyelitis, cold, measles, smallpox, etc., and infects the healthy persons.
3. **From food and drinks:** Germs enter the milk while washing milk with the hands of the sick milkmen and in the same way, mosquitoes pick up germs from dirty places and leave them on food and drinks, which make people sick by eating them and hence diseases spread in this way.

4.3.8 Disadvantages of Viruses

Of all The viruses that have been discovered to date, none of them are beneficial in any way. They only cause diseases, the main reason for which is this is that the viruses only survive within living organisms.

4.3.9 Precautionary measures

There are always countless types of microbes in the universe everywhere. For example, air, water, food, etc. these germs get access to almost every person, but not every person gets sick because the body has a strong immune system against them. Immunity is acquired in two ways. These two methods are used to prevent the virus and these two methods have been proven to be the most effective way to

eliminate the virus. We will mention them briefly here as their description would require a lot of space and a lot of time.

a. Natural method or natural immunity: This defense mechanism can be found in nearly all living organisms. Typically, its effectiveness diminishes with age, and it is inherited from mother to child. As the child matures, their immunity gradually decreases. Additionally, some diseases, once overcome, provide lifelong immunity against those specific illnesses. In the event of future encounters with the same pathogens, the antibodies already existing in the bloodstream neutralize the attacking viruses, as observed in cases such as smallpox and polio.

b. Artificial method or artificial defense force: In this approach, specific pathogens lose their disease-causing capacity while retaining their capability to generate antibodies from the bloodstream. Healthy specimens are sourced from the blood through various methods and encapsulated in vials, commonly referred to as vaccines or antibiotics. Experimental animals known as lab animals are used to produce antibodies. When these pre-formed antibodies are introduced into a patient's system, they promptly develop immunity against the disease, although this immunity may diminish after a few days or weeks.

4.3.10 Self-Assessment Question

Mark the following statement with true or false:

- | | | | |
|---|---|------|-------|
| 1 | Viruses are non-motile. | True | False |
| 2 | A virus is a single-celled organism. | True | False |
| 3 | Deoxy virus is a DNA virus. | True | False |
| 4 | Bacteriophage is a type of bacteria. | True | False |
| 5 | Natural immunity against smallpox can be developed automatically. | True | False |

Key of self-Assessment

1. true
2. true
3. true
4. false
5. true

4.4 BACTERIA

It is a single-celled organism that contains both DNA and RNA at the same time. It was discovered by a Dutch scientist *Leeuwen Hock* in 1675. It can only be seen with the help of a microscope. Its size is five thousand times smaller than one inch.

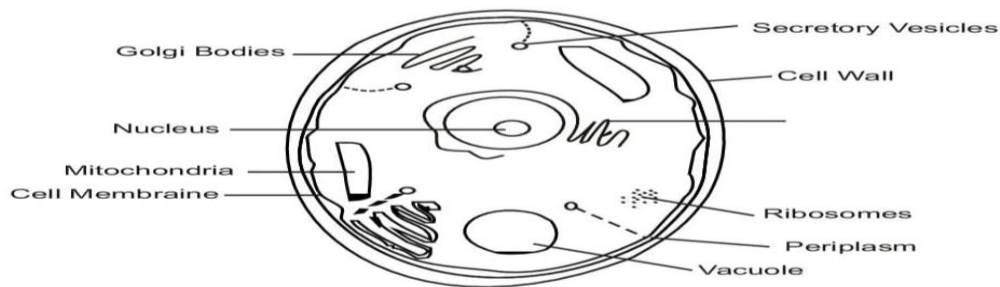
Like a virus, it is measured in microns. Just as a wall is made up of bricks, so an animal is made up of individual cells. Large animals are made up of many cells called multicellular. Bacteria have only one cell, so they are called unicellular organisms. This cell fulfills its needs in the same way as multicellular organisms do. It eats, drinks, breathes, and moves its body, so that it does everything necessary to survive.

4.4.1 Structure

1. Cell Envelope:

- **Cell Membrane (Plasma Membrane):** Bacterial cell has a very thin, flexible, and semi-permeable membrane surrounding the living matter (**figure 4.3**). It regulates the passage of molecules in and out of the cell.
- **Cell Wall:** Many bacteria have a rigid cell wall surrounding the cell membrane. The cell wall strengthens the shape of the bacteria.
- **Cytoplasm:** The bulk of living matter, called the cytoplasm, consists of a fluid called the septum
- **Nucleoid:** Bacterial DNA is found in the nucleoid, which is a region within the cytoplasm. Bacterial DNA is typically a single, circular chromosome.
- **Ribosomes:** Bacteria contain ribosomes responsible for protein synthesis.
- **Plasmids:** Some bacteria contain small, circular pieces of DNA called plasmids. These can carry genes that provide advantages like antibiotic resistance.
- **Appendages:**
 - **Flagella:** Some bacteria have flagella, whip-like structures used for movement.
 - **Pili:** Short, hair-like structures called pili can be present on the cell surface and engage in attachment to surfaces or other cells.

Capsule (not present in all bacteria): A capsule is a protective and sticky outer layer made of polysaccharides. Fig4.3 Bacteria Cell



4.4.2 Bacterial classification

Generally, bacteria are classified based on shapes (**Figure 4.4**):

- a. **Cocci:** They are round shaped like neck bacteria.
- b. **Bacilli:** They are rod shaped, such as the *Pseudomonas* and *Bacillus*.
- c. **Vibrio's:** Curved-rod (comma) shape such as *Vibrio-Cholera*
- d. **Spirilla:** Curved-shaped bacteria such as *Spirillum minus*
- e. **Spirochetes:** Any group of spiral-shaped bacteria, some of which are serious pathogens for humans, causing diseases such as syphilis

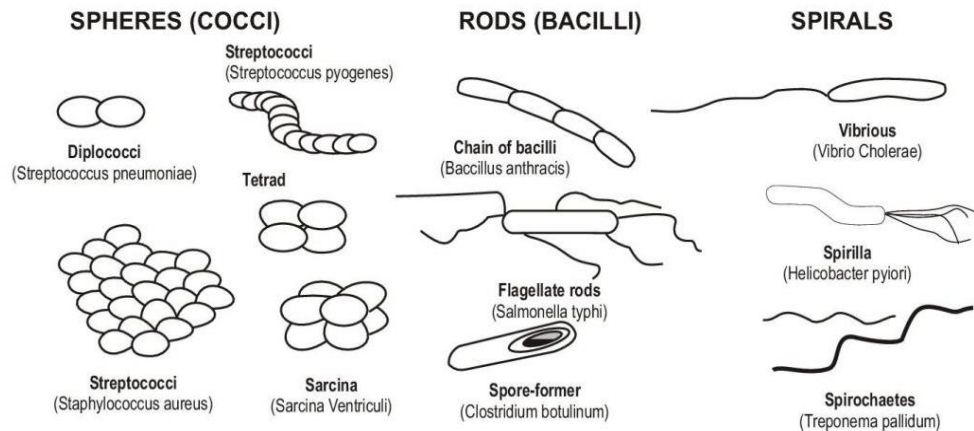


Fig 4.4 shapes of bacteria

4.4.3 Bacterial Spores

In case of unfavorable conditions, the bacterial protoplasm shrinks, and the surrounding cell wall becomes very rigid. This fragmented proto worker is called a spore. In bacteria, the spore is formed inside the cell, so it is also called endospore. Even in the case of unfavorable conditions, these spores survive, which is not suitable environment, their outer hard cell wall is broken, and protoplasm is released, which starts daily activities again. It is a bacterium on a spore, this process of spore formation is called germination of spores. They withstand extremes of heat and cold, even boiling water for up to 17 hours.

4.4.4 Food of Bacteria

Autotrophic bacteria synthesize their own food. They utilize simple inorganic

compounds like carbon dioxide, water, hydrogen sulfide, etc. and convert them into organic compounds like carbohydrates, proteins, etc. to supplement their energy requirements.

Heterotrophic bacteria are mostly responsible for the decomposition of organic matter. They also live as parasites and cause various diseases in plants, animals, and humans. They are also present as a symbiont in organisms, e.g. *Rhizobium* in the root nodules of legumes, etc.

4.4.5 Breeding

They can breed in sexual and asexual ways. Sometimes they can also breed through binary fission. In the process of binary fission, an organism duplicates its genetic material, or deoxyribonucleic acid (DNA), and then divides into two parts (cytokinesis), with each new organism receiving one copy of DNA.

Bacteria can grow in artificial mediums which are also known as media. Each bacterium has its own type of media. Some common media are nutrient media, nutrient agar, blood agar and chocolate agar.

Some bacteria only grow in the presences of oxygen they have known as **Aerobic bacteria** and those bacteria which can grow in the absence of oxygen known as **Anaerobic bacteria** and those who can grow in absences and presences of oxygen are known as **Facultative bacteria**, water is also necessary for them. For the growth of bacteria, a certain temperature is also required like vibrio cholera required 37 degrees centigrade. Those bacteria which can grow at 20 to 45 degrees centigrade are known as **Mesophilic bacteria**. Those bacteria which can grow at 0 to 25 degrees centigrade are known as **Psychrophilic bacteria**. Those bacteria which can grow at 50 to 60 degrees centigrade are known as **Thermophilic bacteria**. The best growth of bacteria can occur at 7.4pH. Each bacterium has its own unique incubation period.

4.4.6 Motility

The state of moving from one place to another is called motility. Living organisms that move are called motile while non-motile are those that do not move. Some bacteria shrink their body for movement and those bacteria that have flagella on their body and they move with the help of them. In each bacterium there are different sequences of flagella.

If the flagella are all over the body, this condition is called Peristriate. If the flagella are present in the form of bunches at the ends, it is called Loffotrichate. If on both sides, there are two flagella then it's called polar flagella but if flagella present on one side it is known as Montrachet.

4.4.7 Transmission of Bacteria

Bacteria are transmitted from a sick person to a healthy person in the following ways:

1. People who have direct contact with a person who has a particular disease that has passed on from one person to another, such as diphtheria.
2. By breathing polluted air such as tuberculosis.
3. By consuming dirty water, such as cholera.
4. Through the injuries, for example gets the disease of sciatica in case of accidents.
5. Bedbugs and lice infested with animal bites are responsible for spreading many diseases. For example, plague is caused by the bite of a flea. When they sit on food and drinks, they leave the bacteria on them.
6. A healthy person becomes ill by consuming this food. For example, cholera, dysentery, etc. People who appear to be healthy but have a certain disease inside their body. These individuals are called Carriers. When these people sit among other healthy people, they transfer the germs to them. Diphtheria and dysentery are spread in this way.

4.4.8 Advantages of bacteria

1. Bacteria are essential for breaking down organic matter and recycling nutrients in ecosystems. They decompose dead plants and animals, returning vital nutrients like carbon, nitrogen, and phosphorus to the soil, making them available for other organisms.
2. Bacteria are used in various fermentation processes in the food industry. They are responsible for producing yogurt, cheese and other fermented foods.
3. Certain beneficial bacteria, known as probiotics, can have positive effects on human health. They can improve digestion, boost the immune system, and promote a healthy gut microbiome. Probiotics are often found in yogurt and dietary supplements.
4. Bacteria are used extensively in biotechnology and genetic engineering. They can be genetically modified to produce valuable products like insulin, antibiotics, and enzymes used in various industrial processes.
5. Some bacteria, such as lactic acid bacteria, are used in food preservation. They produce acids and other compounds that inhibit the growth of spoilage organisms and pathogens, extending the shelf life of certain foods.

4.4.9 Disadvantages of Bacteria

There are some disadvantages of bacteria. They may cause numerous diseases in plants and animals such as:

1. Most of the part of food gets spoiled by bacteria. In this way two types of

- disadvantages occur, first one huge part of food is damaged and when a healthy person eats this food, he might suffer from food poisoning.
2. Some bacteria are pathogenic and cause diseases in humans, animals, and plants. Examples include *E. coli*, salmonella, and streptococcus. These infections can range from mild illnesses to severe, life-threatening conditions.

4.4.10 Self-Assessment Questions

Question for review

1. Write four benefits of bacteria.
2. Write four disadvantages of bacteria.

Correct the wrong statements.

1. Spores are also a bacterium.
2. Montrachets bacteria has one flagellum on their head.
3. Basophilic bacteria can grow at 30 to 60 degrees centigrade.
4. Flies cause contagious diseases.
5. Bugs causes cholera.

4.5 FUNGI

Fungi exhibits a wide spectrum of forms, ranging from single-celled to highly intricate multicellular structures (**figure 4.5**). Their presence is not restricted to any environment, as they can be encountered in diverse habitats. However, most fungi thrive on land, primarily inhabiting soil or residing on plant materials, in contrast to marine or freshwater environments. Among these fungi, a specific category known as decomposers thrives in soil or on decaying plant matter, where they fulfill a vital role in the recycling of carbon and various other elements. Additionally, some fungi act as parasites to plants, leading to the development of plant diseases such as mildews, rusts, scabs, or canker. When these fungal diseases affect crops, they can result in substantial financial losses for farmers. It's noteworthy that only a small subset of fungi is responsible for causing diseases in animals, including humans. In humans, these fungal infections manifest as skin conditions such as athlete's foot, ringworm, and thrush.



Fig 4.5 Fungi

4.5.1 Characteristics of Fungi

Here are the key characteristics of fungi:

1. **Eukaryotic and Heterotrophic:** Fungi are composed of eukaryotic cells and rely on external sources for nutrients, making them heterotrophic organisms.
2. **Unicellular or Filamentous:** Fungi can exist in either single-celled or filamentous (multi-celled) forms.
3. **Reproduction by Spores:** Fungi reproduce through the formation and release of spores, which are specialized reproductive cells.
4. **Alternation of Generation:** Fungi exhibit alternation of generation in their life cycles, involving both haploid and diploid stages.
5. **Lack of Chlorophyll:** Unlike plants, fungi lack chlorophyll and are unable to perform photosynthesis.
6. **Food Storage:** Fungi store their excess food in the form of starch.
7. **Chitin Biosynthesis:** The cell walls of fungi are composed of chitin, a structural carbohydrate.
8. **Small Nuclei:** Fungal nuclei are typically very small compared to those of plants and animals.
9. **No Embryonic Stage:** Fungi do not go through an embryonic stage in their development; they grow directly from spores.
10. **Sexual and Asexual Reproduction:** Fungi can reproduce both sexually and asexually, depending on the species and environmental conditions.
11. **Parasitic Ability:** Some fungi are parasitic and can infect other organisms, causing diseases or infections.
12. **Pheromone Production:** Fungi produces pheromones, chemical signals that play a role in initiating sexual reproduction.
13. **Examples:** Common examples of fungi include mushrooms, molds, and yeast.

These characteristics collectively define the diverse group of organisms known as fungi, which play significant roles in various ecosystems and have numerous practical applications, such as in food production and medicine.

4.5.2 Classification of Fungi

Kingdom Fungi are classified based on different modes. The different classification of fungi is as follows:

Based on Mode of Nutrition

1. **Saprophytic Fungi:** These fungi obtain their nutrition by consuming dead organic matter. Examples include *Rhizopus*, *Penicillium*, and *Aspergillus*.
2. **Parasitic Fungi:** Parasitic fungi obtain their nutrition by living on other living organisms, which can be either plants or animals, and absorb nutrients from their host. Examples include *Taphrina* and *Puccinia*.
- **Symbiotic Fungi:** Symbiotic fungi form mutually beneficial relationships with other species. Two prominent examples are **Lichens**: Lichens are a symbiotic association between algae and fungi. In this relationship, both algae and fungi benefit. Fungi provide shelter and protection for algae, and in return, algae perform photosynthesis and produce carbohydrates that the fungi can utilize.
- **Mycorrhiza:** Mycorrhiza is a symbiotic association between fungi and plants. In this relationship, fungi enhance the nutrient absorption capabilities of plants, particularly minerals from the soil. In exchange, plants provide organic molecules, such as sugars, to the fungi.

These different modes of nutrition highlight the adaptability and ecological roles of fungi in various ecosystems, from decomposing dead matter to forming crucial partnerships with other organisms for mutual benefit.

Based on formation of spores

Kingdom Fungi can be categorized based on the formation of spores into the following groups:

1. **Zygomycetes:** Zygomycetes are characterized by the fusion of two different cells during sexual reproduction. The resulting sexual spores are known as zygospores, while asexual spores are termed sporangiospores. Zygomycetes typically have hyphae without septa (cross walls). An example is the genus *Mucor*.
2. **Ascomycetes:** Also known as sac fungi, Ascomycetes exhibit a variety of lifestyles, including coprophilous (associated with dung), decomposers, parasitic, and saprophytic. Their sexual spores are called ascospores, and asexual reproduction involves conidiospores. *Saccharomyces* is an example of an Ascomycete.
3. **Basidiomycetes:** Basidiomycetes are often recognized by the presence of mushrooms and are frequently parasitic. Sexual reproduction in this group is through basidiospores, while asexual reproduction can occur through conidia, budding, or fragmentation. The common mushroom *Agaricus* belongs to this group.

4. **Deuteromycetes:** Also known as imperfect fungi, Deuteromycetes do not follow the conventional sexual reproduction cycle seen in other fungi. They lack a recognized sexual phase and reproduce exclusively asexually through conidia. Trichoderma is an example of a Deuteromycete.

These classifications based on spore formation help differentiate the diverse forms and reproductive strategies within the fungal kingdom. Each group exhibits unique characteristics and ecological roles, contributing to the overall diversity and significance of fungi in various ecosystems.

4.5.3 Uses of Fungi

Fungi indeed holds a significant position in the natural world, contributing both positively and negatively to various aspects of life. Here are some important uses and impacts of fungi:

1. **Recycling:** Fungi are crucial in the ecosystem as they play a vital role in breaking down and recycling dead and decaying organic matter. They are nature's recyclers, helping to decompose and return nutrients to the soil.
2. **Food:** Certain mushroom species that are cultivated are not only edible but also serve as a nutritious food source for humans. Mushrooms are used in a variety of culinary dishes.
3. **Medicines:** Fungi is the source of several important antibiotics and medications used in human and animal healthcare. The famous antibiotic penicillin is derived from the fungus *Penicillium*.
4. **Biocontrol Agents:** Some fungi act as biological control agents by parasitizing or infecting pests and insects that harm crops. Fungal spores are employed as a natural and environmentally friendly method for pest control in agriculture.
5. **Food Spoilage:** While fungi contribute positively to decomposition, they can also have a detrimental impact on stored food items. Fungal growth can lead to food spoilage and economic losses, necessitating proper storage and preservation methods.

In summary, fungi have a multifaceted role in the environment and in human affairs. Their ability to break down organic matter, provide food, produce medicines, aid in pest control, and cause food spoilage underscores their importance and the need for understanding and managing their impact.

4.5.4 Examples of Fungi

Following are the common examples of fungi:

- Yeast

- Mushrooms
- Molds
- Truffles

4.6 MOLDS

4.6.1 Shape and General Characteristics

It is a multicellular organism. These organisms have thread-like bodies called hyphae. These hyphae form a type of web called a mycelium consisting of many branches. Hyphae is made up of many cells (**figure 4.6**). The cell also has a nucleus. There are also multiple nuclei. The hyphae have a wall at the end of each cell. In this way the hyphae are seen per separate cell. This condition is called septation.

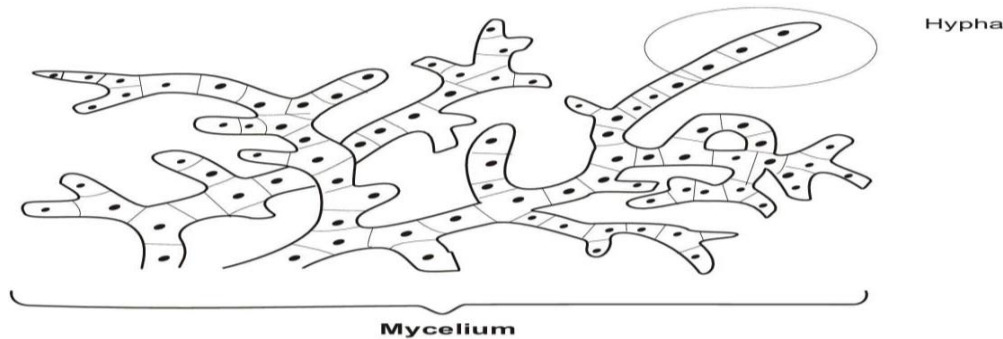


Fig 4.6 Molds

In adverse conditions, hyphae undergo a transformation, assuming a spherical form encased by a tough substance. This state of sphericity is referred to as a "Sclerotium," and if there are multiple such structures, they are known as "Sclerotia." Under these conditions, they can endure for extended periods, ranging from months to years. When favorable conditions return, they shed their protective shells and resume their normal life cycle. Molds can display a range of colors, including white, yellow, red, brown, and orange. Common mold species include *Penicillium*, *Aspergillus*, and *Mucor*.

4.6.2 Breeding

It reproduces asexually and sexually during suitable conditions. Heat and moisture are suitable for their growth and development.

4.6.3 Economic Importance - (Advantages and Disadvantages)

Blue molds (Penicillium) or Aspergillus destroy large amounts of food. Also, the daily use items are not far from their influence, such as leather and thread, both molds are our worst enemies because they damage our food crops. They damage

flowering plants and cause many diseases that cause damage to our pets. They can cause lung diseases in humans such as Aspergillus. There are some advantages of molds such as Penicillin, which is a very good antibiotic drug made from the green mold. With their help, some types of acids and vitamins are also produced.

4.7 YEAST

4.7.1 General Properties

It is a single-celled organism that thrives on sugary substances that also contain small amounts of nitrogen and sulfur. Like grapes, they are present on the outer surface of dates and sugarcane as well as in fruit juices. It is also found in animal waste and different parts of plants.

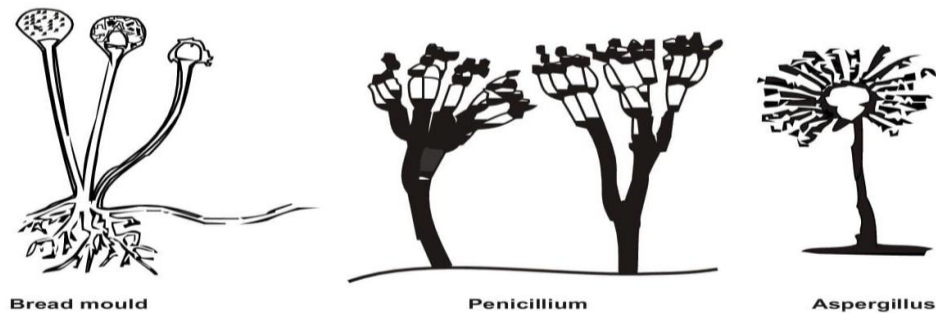


Fig 4.7 Mold species

(Figure 4.7)

4.7.2 Structure

In yeast, the Mycelium is not like the branches but lies in a separate cell. These cells may be round, oblong to persistent, or bifid. Their size is a hundred times smaller than one millimeter. They have a regular cell wall with protoplasm inside. In the center of the cell is the nucleus as shown in figure 4.8.

4.7.3 Food of Yeast

Unlike other fungi, they do not contain chlorophyll. They are usually saprophytic. They live in such sugars which contain small amounts of nitrogen and Sulphur. The yeast makes two types of enzymes that destroy sugar. These enzymes are inverters and zymogens which convert sugar into alcohol and carbon dioxide.

4.7.4 Breeding

They breed in two ways:

1. Asexual breeding

2. Sexual breeding

1. **Asexual breeding:** There are two types which are explained below:

a. Budding: When food is abundant then breeding is done by budding. The mother cell produces a shoot that gradually grows until it reaches the size of the mother cell. The adjacent part of the two cells takes the shape of a posterior neck. Until they separate and become two cells (**figure 4.9**).

b. Fission: The nucleus of the mother cell divides into two nuclei, a wall forms

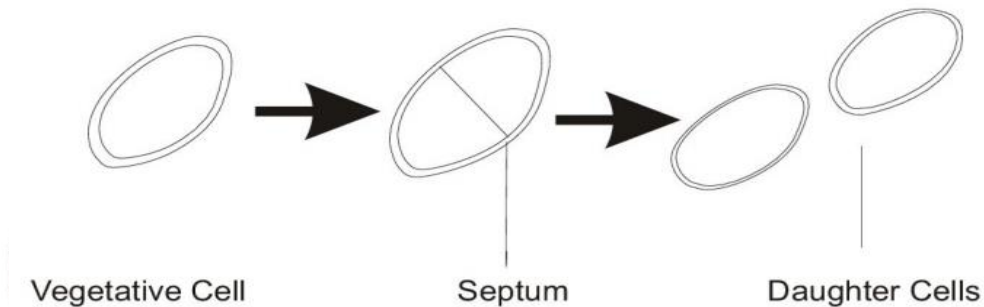


Fig3.10 Binary Fission of Yeast

Fig 4.9 Budding

between the mother cells in such a way that each divided nucleus goes into a separate compartment, as well as half of the cell material. In this way mother cells are divided into two parts. Each cell contains a nucleus

2. **Sexual breeding**

This method of reproduction is adopted when there is a shortage of food and water. The union of the two cells forms the zygote in which four or eight different spores are formed. In the yeast, the zygote takes the form of a bag called an ascus. This ascus forms four or eight spores called ascospore. When these spores are scattered in the air, they are divided by the method of budding and fission.

Types of yeast: There are generally three types which are as follows:

a. Industrial or (True, yeast): It is used in the bakery industry to raise the moisture in baked goods.

- b. **Wild Yeast:** This is on top of grapes and other fresh fruits. In ancient times this paste was used to make wine in western countries.
- c. **False Yeast:** Like the true yeasts but they don't form spores for example Candida and Mycoderma.

4.7.5 Economic Importance Advantages and Disadvantages

It is frequently used in bakery and alcohol-making industries because it removes moisture from the yeast and produces carbon dioxide and alcohol. Alcohol is used in the brewing industry while carbon dioxide is used in the bakery industry.

Yeasts also cause diseases in fruit trees and plants and make humans irritable and nervous system disorders occur.

4.7.6 Self-Assessment Questions

Fill in the blanks.

1. Mycelium is formed by the combination of _____.
2. Yeast contains _____ and _____.
3. Yeast form _____.
4. Molds are _____ organisms.
5. Due to unfavorable conditions molds obtain the shape of _____.
6. In fission mother cell divided into _____ cells.
7. Penicillium is a type of _____.

Key of Self-Assessment

1. Hyphae
2. Invertase and zymase
3. Alcohol
4. Multicellular
5. Sclerotium
6. Two
7. Molds

UNIT 5

FOOD AND WATER BORNE DISEASES

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5.1 INTRODUCTION

Water and food are nature's priceless gifts to all creatures; sometime the things we eat, and drink can carry tiny, harmful germs that can make us sick. These germs can spread easily from one person to another, and they do not care if you live in a small village or a big city.

In this chapter, we will learn about the germs that cause diseases, what symptoms they can give you, and how doctors figure out if you have one of these illnesses. We will also talk about how you can protect yourself and your community from getting sick from contaminated food and water.

5.2 OBJECTIVES

After reading this chapter, you will be able to understand:

1. Viral and infectious diseases caused by microorganisms.
2. Different steps that can be taken to prevent them.
3. Human health care can be provided through both individual and group efforts by learning about microbe-caused disease preventive methods.

5.3 VIRAL DISEASES SPREAD THROUGH WATER AND FOOD

Virus only thrives in and on living things. Therefore, food and water are the only means of transmission of the virus from one organism to another. The types of viruses that enter the human stomach through food are called Enteroviruses. The main and common viral diseases that are transmitted to humans through food and water are polio and Infectious Hepatitis, which are described below.

5.3.1 Polio

It is also called infantile paralysis. Its particles are often excreted in the feces of the patient, from where they reach the stomach through the food and water of another healthy person. They continue to be excreted long after the patient has recovered and can be an important source of disease spread. After reaching the stomach, these viruses continue to enter the bloodstream or lymphatic system. Also, by touching a sick person, by putting his used clothes on and better use, by eating his food, a healthy person becomes infected with this disease. That is why he/she is also called contagious patient. After recovery, some of the patients become paralyzed. Most paralysis occurs in the legs. This disease affects children under two years of age.

1. **Symptoms:** Symptoms of the disease begin with fever and twitching of muscles. Sometimes the body becomes weak or paralyzed. Most often one or both legs are paralyzed. With the passage of time, the paralyzed leg becomes thinner. And it does not flourish like the other leg and often dries up. Death also occurs in the severity of the disease.
2. **Characteristics of polio virus:** As mentioned earlier, this virus belongs to enteroviruses. That is, those viruses that reproduce in the stomach and its related parts. It is an RNA virus with a size of up to 27 milli microns. A person who has been infected with polio becomes immune to polio for the rest of his life. The virus can be isolated from the patient's stool or throat swabs in the laboratory.
3. **Precautions:** After the onset of the disease, no medicine can remove the paralysis. Antibiotics are ineffective against polio. However, aspirin can be used to reduce pain. Mattresses soaked in hot water can be used to provide relief to these sore muscles. The patient should be kept away from healthy children. Hands should be washed with soap every time after touching sick children. A child with paralysis should be fed a nutritious diet. Exercises should be done to strengthen the remaining muscles. Some strength may be restored during the first year after the disease. A child should be taught to walk as early as possible. During the previous century, this disease was very common in Pakistan. But now it has been overcome. Nowadays, the government has decided to administer polio drops in hospitals. Also, instructions for this are often given on television and radio. So that children can be protected from this deadly disease by administering polio drops in time. If every

individual takes interest in this matter and if the polio vaccines is used on time, there is no reason why we cannot save our new generation from polio.

4. **Polio vaccine:** Polio vaccine consists of two vaccines. One is given by injection and the other by mouth. The injection contains dead bodies (Killed vaccines) of the polio virus, while the live bodies (live vaccine) are in the drops. The ability of living organisms to cause disease is eliminated. The use of polio drops is common today. This, on the one hand, induces local immunity in the esophagus. Second, from here, the antibodies enter the bloodstream. It does not spread the virus to the nervous system. These drops should not be given to children who have suffered from diarrhea or tuberculosis. Apart from this, a regular campaign has been started at the government level for the complete elimination of this disease. To accomplish this, in accordance with a predetermined timetable, teams dedicated to polio vaccination visit homes, hospitals, dispensaries, and various healthcare facilities, ensuring that every child under the age of five receives the necessary polio drops, leaving no one unvaccinated. Due to this campaign, this disease has been largely controlled.

The child should be given drops according to the following schedule.

Age	Dosage of polio drops
At the time of birth	First dose
2 months	Second dose
3 months	Third dose
4 months	Fourth dose
6 months	Fifth dose
4 years	Sixth dose

5.3.2 Infectious Hepatitis

In this disease, the patient's liver becomes inflamed, which can have many causes. This disease is caused by toxins from different types of viruses. For example, Rubella Virus, Adeno Virus, Herpes Virus, Herpes Virus, etc., but this type of hepatitis is spread by two types of viruses. One is called meningitis virus Infections Hepatitis Virus, and the other is called Serum Hepatitis Virus. Sometimes this disease is also caused by bacteria like Leptospira.

Its virus is shed in the patient's feces and urine, from where it somehow gains access to healthy people through food and drink. These viruses also spread from person to person through airborne droplets. Its latent period is about 4 days.

1. **Symptoms:** The patient's body becomes deficient in blood due to which eyes turn yellow. Urine becomes pale yellow. Patients often complain about the pain in their liver and become lazy with the disease progression. There is also a complaint of fever and appetite gradually disappears.

2. **Preventive measures:** Hepatitis disease is very prevalent nowadays, there are different types of which are more common in Pakistan. A vaccine has also been invented for this disease, which is given according to the vaccine schedule after the birth of the child. Apart from this, adults are also vaccinated against this disease, but unfortunately, this disease could not be completely controlled, but due to various reasons, this disease is spreading rapidly. It is hoped that in a few years this disease will be controlled due to preventive measures. If a person got an infection, the patient should be taken to the doctor immediately. Patients should feed clean and soft (liquid) food. The patient's saliva, urine and feces should be disposed of by all means as soon as possible. Also, utensils and things used by the patient should be kept away from healthy people.

3. **Diarrhea due to Rota Virus:** Rotavirus causes severe diarrhea in humans and animals. Usually, children are more prone to this disease. There are many other causes of diarrhea in children. This virus contaminates food and drink through the air. These foods cause diarrhea when children eat them. The latent period of infected virus is very short. Symptoms of diarrhea begin 24 hours after the virus enters the body. Death also occurs due to dehydration in the patient's body. To prevent this disease, it is important to keep the food and drinks from being contaminated with dust, dirt, flies, and other dirty things. The mother should breastfeed the baby. It develops immunity in children against the disease. Scientists are busy in research for the prevention of this disease. It is hoped that sooner or later they will be able to make a vaccine that will eradicate this disease.

5.3.3 Self-Assessment Questions

1. Write 4 reasons for transmission of polio?
2. Write down the 4 properties of polio virus?
3. Write 4 precautionary measures of polio?
4. List the symptoms of infectious liver disease?

5.4 BACTERIAL DISEASES SPREAD THROUGH FOOD AND WATER

All the necessary things required for bacterial growth are found in diet, therefore they flourish well in the diet. They take all the necessary things (protein and salts) from the diet. In return they leave toxins in it. The diet which contains toxins in food as well as infecting bacteria, when consumed by humans, causes various infectious and epidemic diseases. And we say that a person has food poisoning. Poisoning is caused by many types of bacteria, and we will discuss the most common and important ones here.

5.4.1 Staphylococcus

They are also known as gram positive bacteria. These bacteria are commonly found in the surrounding water and on everyday items. Apart from this, they are also abundantly present in the human skin, nose, throat, esophagus, etc. A special type of staphylococcus, *Staphylococcus aureus*, is of particular importance to human health because it can grow in the presence of salts, whereas most bacteria lack this ability. About 50% of these bacteria produce high levels of enterotoxins in food that cause disease in humans. Most of the poisons lose their effect at high temperatures, but these poisons remain dangerous to human health even in boiling water for 50 minutes. This bacterial disease is the most common of the human food borne diseases, but its effects are less common than other diseases.

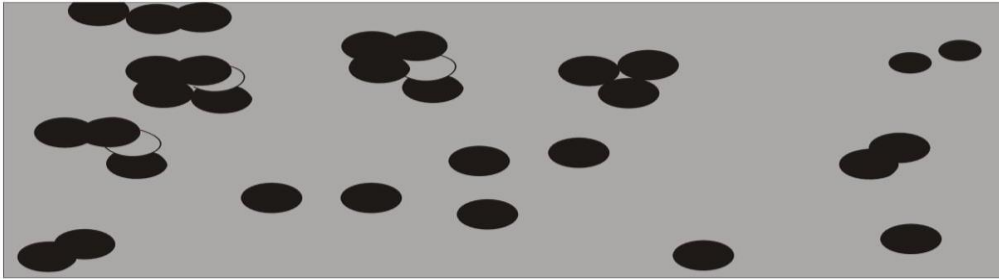


Figure 5.1 Staphylococcus

Staphylococcus

1. **Symptoms:** Signs Symptoms of this illness start to appear within 4 hours after eating contaminated food. In most cases people feel nausea and suffer from vomiting. Other common symptoms include abdominal pain and diarrhea. These symptoms of disease usually last for 1 or 2 days. The death rate in this disease is very low. It is believed that many bacteria must be present in food to cause disease. According to an estimate, it should be 1 to 100 million per gram.
2. **Mode of transmission:** The human body plays the most important role in spreading this disease because 30-40% *Staphylococcus aureus* are present in the guts of healthy people. It is spread mostly by mucus. It is also found in significant amounts on human hair. Animals can also be helpful in spreading it. These bacteria are often present on the udders of dairy animals. A particular disease of animals, mastitis, can also be caused by this bacterium, where the bacteria can be transferred into milk. Milk can also be contaminated from the utensils used in milking and the hands of the workers. It is also present on chicken meat, but there it is not of much importance. Cooked foods that are contaminated with these bacteria spread the disease. Especially when the food is kept warm for a long time. This disease can

also be caused by using cold meat. For example, low-fat foods include egg-based products such as custard cream-based bakery products, cheese, and high-fat dairy products such as cheese. Canned food, if contaminated with this bacterium during cooking, can also prove to be a threat to human health.

3. **Precautions:** The most important thing to avoid this disease is to protect human food from these bacteria. The following are the necessary precautions in this regard. As far as cooked food is concerned, one should not touch it, especially if it is meant to be kept in a warm condition for a long time. If handling is necessary, it is best to cool it down to 20 degrees centigrade.

Food should not be touched by an infected person.

Food should be heated well. If the food is intended to be stored for a long time, keep it at 10-degree centigrade or below.

Utensils used in milking, raw milk, and dirty areas are often full of disease-causing organisms, and should be kept as clean as possible to minimize food contamination.

5.4.2 Clostridium

They are rod-shaped. Their growth occurs in the absence of oxygen i.e., these bacteria are anaerobic. These can naturally be divided into three groups.

1. **Gas- Gangrenes:** In this condition, they spread the disease when there are deep wounds in the tissues and the immune system is low.
2. **Tetanus:** Produces toxin which is fatal.
3. **Botulinum:** They produce enterotoxin in the diet, the ingestion of which can lead to death.

Based on their importance in food, the details of the varieties are given below.

5.4.2.1 Clostridium perfringens

It is also known as *Clostridium welchii*. It grows in the presence of low or no oxygen. Favorable temperature for growth of these bacteria is about 15-45 degree centigrade. Its spores are not killed even by 2 to 5 hours boiling

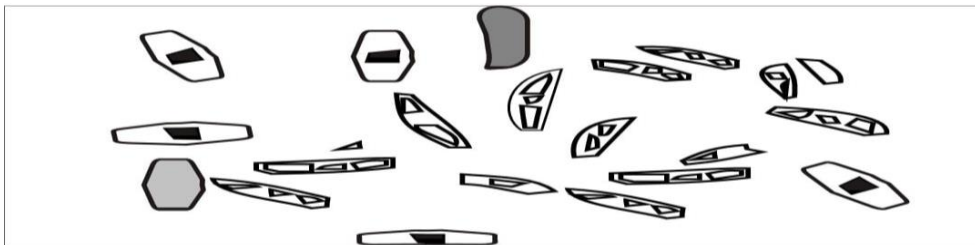


Fig 5.2 clostridium perfringens
(figure 5.2).

1. **Signs and Symptoms:** The symptoms of this disease begin to appear within 6 to 22 hours. The patient experiences severe abdominal cramps along with diarrhea. Usually, the patient does not exhibit feverish or coughing symptoms. These symptoms of the disease get better within 12 to 24 hours, while in elderly people it may take up to two days. The survival rate of this disease is also very low.
2. **Disease outbreaks:** Meat of animals and poultry is usually contaminated with it. Its contamination of food is usually high in places where hygiene rules are not considered while preparing food, for example, in institutions like hospitals and canteens etc. If the food is not cooked well, then this germ which is in the state of spore is not eliminated so easily. Adulterated food can pose a risk to human health if it is stored at room temperature and is not properly heated and consumed.
3. **Precautions:** As far as possible, food should be eaten immediately after cooking. If the food is intended to be kept for a long time, it should be cooled immediately and kept in the refrigerator. Hot food should be avoided in the fridge as it takes longer for the food to cool down. And late cooked food should be heated well before eating. Try to prevent the cooked food from contamination with germs and meat.

5.4.2.2 Botulism

It is caused by *Clostridium Botulinum* (figure 5.3). There are seven varieties of it like perfringens. Through food, some of them propagate illnesses among humans and some animal species. The suitable temperature for their growth is 37 to 50 degrees centigrade. It is very resistant in the form of spores and does not die even



Fig 5.3 Clostridium Botulinum

after six hours of boiling. The lethality of this food can be estimated from the fact that one gram of it can kill one million people. This toxic substance is absorbed in the human intestines through food and enters the blood. From here it reaches the nervous system which causes danger to human life.

1. *Symptoms:* The first symptoms of this disease appear within an hour or so of eating contaminated food. But there can be intervals. The earlier the symptoms of this disease appear, the less there is a hope for the survival of a person. The patient feels nausea and experiences various episodes of vomiting. This is also accompanied by diarrhea. Nervousness, headache, and lethargy are common symptoms of this disease. Before the onset of the disease, there is a complaint of constipation. Vision becomes blurred. The patient has trouble speaking and chewing. Signs of fatigue are prominent. Fever does not occur at all, but the temperature of the human body decreases. In severe disease, human respiratory and heart system may become paralyzed, and this can lead to death. In case of survival, the patient recovers slowly. For the treatment of this disease, the patient is given Antitoxin as well as strong drugs and gradually the person recovers.

2. *Mode of transmission:* Although the bacteria are found abundant in nature, very small amounts are found in fresh water, sea water and soil. If these sources contaminate human food, it can cause disease. Foods that are usually stored in sealed containers, such as meat, vegetables and fruits, legumes, and other marine animals, play an important role in the transport of these bacteria to the human body. Along with food and drink items that create a supportive environment for their growth, these rodents produce deadly toxins. which poses a risk to human life. For an outbreak of this virus, food composition, optimum temperature, long shelf life, moisture ratio, and salt content are crucial.

3. Precautions:

Precautionary measures are as follows:

The food sealed in boxes and bottles should be heated well so that the spores of this food are destroyed.

Care must be taken to prevent hands or other contaminated objects from spreading these to the cooked meal if these containers are to be chilled outside.

Where low temperatures are used in food preparation, sterilizing compounds should be used with care, or the pH is too low for microorganisms to flourish.

5.4.5 Self-Assessment Questions

Fill in the blanks with suitable answers.

- a. Food poisoning is caused by consuming.
- b. Toxins.
- c. Bacteria.
- d. Virus
- 1. _____ can also develop in the presence of salts. Germs

- a. Staphylococcus
- b. Enterotoxin
2. In animals, _____ is caused by Staphylococcus.
 - a. Pox
 - b. Mastitis
 - c. An abscess
3. In food, 50% of Staphylococcus species produce _____.
 - a. Toxins
 - b. Enterotoxin
4. Infection Staphylococcus aureus is most usually spread via _____.
 - a. 10-20
 - b. 15-45
 - c. 20-60
5. Clostridium growth occurs when _____ is absent.
 - a. Carbon dioxide
 - b. Oxygen
 - c. Hydrogen
6. The optimum temperature for the growth of fringes on Clostridium is _ - _____ Celsius.
 - a. 10-20
 - b. 15-45
 - c. 20-60
7. Clostridium botulism is caused by _____.
 - a. Gas fistula
 - b. Botulism
 - c. Mastitis.
8. After sealing the food should be cooled with _____ water.
 - a) Salt
 - b) Chlorine
 - c) Iodine

Key for self-assessment questions

1. Toxins
2. Staphylococcus
3. Mastitis
4. Enterotoxin
5. Mucus
6. Oxygen
7. 25–45
8. Botulism
9. Chlorine

Practical

Find out the percentage of children in your neighborhood who are not using drops of polio vaccine. Identify the reason, and then persuade them to utilize the drops.

5.5 CHOLER This deadly disease is caused by a bacterium that has a comma-like shape and is called *Vibrio cholera* (**figure 5.4**). These germs keep proliferating inside of the patient's body and get eliminated through their stools and vomit.

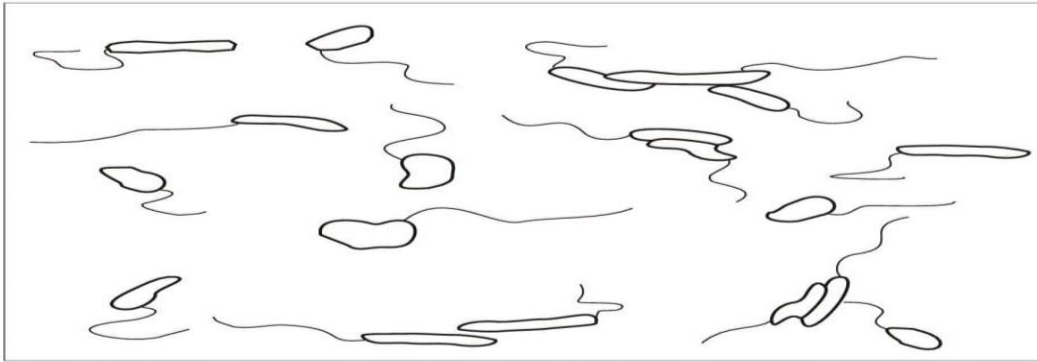


Fig 5.4 Vibrio cholera

These enter the food and drinks in different ways and then reach the stomach through the mouth and cause disease. This disease is common in India. It only affects humans. They grow only in the presence of oxygen. Without it, their growth stops. Their optimum temperature is 25-35 degrees Celsius. Under normal circumstances, they are killed within few hours. Their spores are quickly killed by distilled water and other disinfectants. They cannot tolerate high temperatures. They can survive for short periods in water and land. However, if it is present in food and salad, it survives for two or four days.

5.5.1 Symptoms

Symptoms of the disease appear over a period of a few minutes to ten days. They get nourishment in the small intestine. They die almost as fast as they proliferate. Other symptoms include severe pain and nausea. Initially, there is no fever, if it occurs, it is nominal and severe pain occurs with abdominal cramps. Diarrhea remains constant and the number from which several gallons of water are released from the body. Diarrhea later looks like rice water, urination stops. The skin gets pimples. The eyes sink and the pulse quickens. Circulation slows down. Eventually, this leads to coma and death may occur in some cases.

5.5.2 Mode of transmission

Contaminants are found in drinking water, such as water from river wells and washing clothes of the patient. They are also found in milk. These can enter the milk by mixing contaminated water with milk from dirty hands or using dirty utensils. A person who consumes this milk may suffer from this disease. Affected healthy people carry spores in their bodies, called carriers, often excreting these spores, which spread the disease.

5.5.3 Precautionary Measures

The following precautionary measures should be taken.

1. Grains like pulses should be thoroughly boiled and cooked.
2. Raw and overripe fruits should not be taken. Similarly, rotten things should not be used at all.
3. Cold things like ice cream should not be eaten.
4. All food and drink should be covered so that flies do not sit.
5. In the days of cholera epidemic, no medicine should be used.
6. Drinking water should be boiled. Milk should not be drunk without boiling.
7. If a cholera epidemic spreads in the area, Potassium Permanganate should be used in all wells and ponds of the infected area.
8. Also, during this time, no one should wash clothes near the wells or bathe there.
9. Toilets and drains should be kept clean during the days of epidemics. Add formalin to them.
10. Wherever there is an outbreak of cholera, it should be immediately reported to the officers of the Health Department. The patient should be kept away from healthy people. And the doctor should be approached.

5.6 SALMONELLOSIS

These are types of bacilli that can cause disease in animals, birds, and humans. These foods can be divided into three groups based on their pathogenicity: Primarily the pathogens that infect humans and cause sickness. *Salmonella typhi*, *Salmonella paratyphae* also known as *Salmonella paratyphae B*, *Salmonella paratyphae C*. The groups mainly cause disease in animals and birds. But they can also cause disease in humans. For example: *Salmonella Cholera Avis*, *Salmonella typhimurium*. The third group also causes disease in animals and birds but cannot cause disease in humans at all, for example *Salmonella gallinarum* and *Salmonella pullorum*.

They die within 15 to 20 minutes at 60 degrees Celsius. However, they live for a long time in natural conditions. In frozen conditions, these bacteria can live for up to a year. However, they live for 7 to 10 days in the water of a well. They can live up to three months in the state mixed with waste.

5.6.1 Symptoms

These germs can spread to both humans and animals. Symptoms of this disease start within 12 to 24 hours after eating the germs. Nausea is an early sign of the disease. In addition, there is slight fever, diarrhea, and abdominal pain. The patient may lose consciousness, and the stools are usually green in color, watery in consistency, and have an unpleasant smell. A two percent mortality rate is average. Children up to one year of age fall victim to this disease quickly, while adults usually do not suffer from this disease. This disease usually lasts for two to three days, but some symptoms persist for weeks or even months.

When a disease is severe, many of the disease's germs are expelled with human stool, and this amount reduces as the patient gets well.

5.6.2. Mode of transmission

Mainly this virus is spread through goat and chicken meat. According to an estimate, 35% of the meat of chickens is contaminated with these diseases causing pathogens. Sometimes, a large amount of meat is cooked and refrigerated to keep it for a long time and when reheated for eating, it is not heated enough to kill these pathogens. Cattles that are slaughtered in slaughterhouses can be contaminated with this pathogen. In developing countries, the number of such animals is up to 5%, in cages where sanitation is not good, there is a high chance of spreading of the disease through meat. Meat from diseased animals is sometimes added to the feed of pets and poultry, from which the disease spreads to domestic animals and eventually to humankind.

5.6.3 Precautions

Care should be taken so that animal feed is not contaminated. These germs should be eliminated from the chicken houses.

1. Kitchens and factories should be prevented from being contaminated by raw food.
2. There should be sufficient arrangement of cleanliness in the range boxes.
3. Avoid storing cooked items at room temperature. If possible, such things should be kept in the refrigerator.
4. It should be ensured that there are no such foods in the food preparation areas.
5. There should be no passage of rodents, birds, and insects in and out of food processing factories.

5.7 TYPHOID

It is also called chronic fever or fever. This disease is common in our country. It is caused by *Salmonella typhi* (**figure 5.5**). Food poisoning does not happen with this disease. However, there is typhoid fever which is very deadly. Its toxins are found in the patient's blood, urine and feces are sometimes found in his mucus and even his sweat and the duration of this disease is ten to fifteen days.

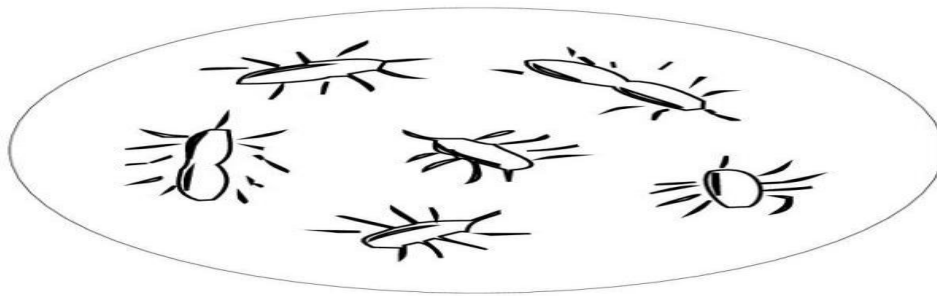


Fig 5.5 *Salmonella typhi*

5.7.1 Symptoms

The patient walks and goes about his daily business for six to seven days without knowing that he is unwell. Health remains in decline though. The patient stops feeling hungry and experiences head, hand, and foot pain. Fever and headache continue. Some patients also have diarrhea at first. But constipation is the main complaint among patients. Small intestine ulcers and sores develop during this condition. The fever rises two degrees in the evening and falls one degree in the morning for four to five days. The temperature normally stays the same during the second week. The temperature normally stays the same during the second week. The temperature rises to 99 degrees centigrade in the morning and 101 or 102 in the evening for four or five days during the third week. The patient starts to recover in the fourth week when the temperature starts to rise in the morning and then returns to normal in the evening. Pink patches start to show up on the chest, abdomen, and head starting on the seventh day of the fever. These zits go away in two to four days, after which new spots start to diminish in number.

5.7.2 Mode of transmission

Consuming water and milk containing this bacterium's contents causes typhoid. Flees pick up germs from the dirt of the patient and put them in food and drink, the person if consumes such food and drink becomes sick. Direct contact with affected people can cause this disease. Hence special care should be done while treating

them. Often, bread makers, sweets sellers and milk sellers carry the toxins of the bacterium, pass it on to healthy people through these things.

5.8 BACILLUS CEREUS

This bacillus is prevalent in both soil and water. Normally it exists in the spore state. In favorable conditions when the temperature ranges between 100 and 180 °C, it takes the form of bacteria (**figure 5.6**). Roughly 80% of the types of this bacterium produce a toxin called **endotoxin**, which has two types. Heat to 56 °C to destroy the first type, and heat at 126 °C for 90 minutes to destroy the second type. This kind is hazardous.

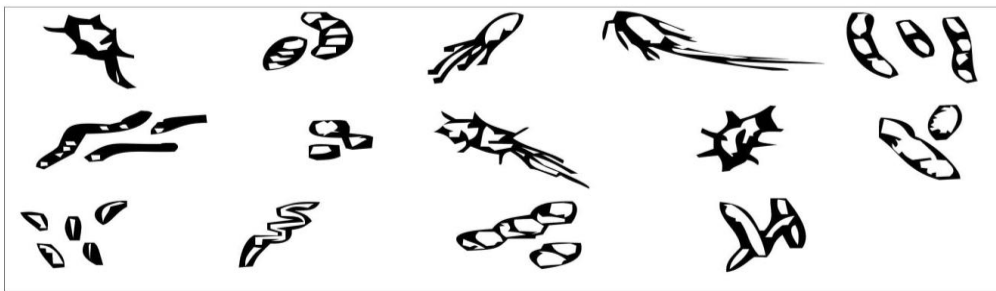


Fig 5.6 BACILLUS CEREUS

5.8.1 Disease Symptoms

The human body is affected by these bacteria in two different ways. The first kind of illness resembles that produced by *Clostridium perfringens*. Within 8 to 16 hours, these symptoms begin appearing. The patient experiences severe abdominal discomfort. Along with this, nausea, vomiting, and diarrhea start. Additionally, fever may develop. After a day, these symptoms gradually disappear.

Symptoms of the second type of infection are like those caused by staphylococcus aureus which begin to appear within 5 hours. The patient feels nausea and frequently vomits. The duration of this disease is 6-24 hours.

5.8.2 Mode of transmission

As mentioned earlier, this bacterium is found in water and soil, from where it is transferred to pulses and vegetable plants. These fruits and vegetables spread the disease. If the food is not cooked properly, then this pathogen, which is in the state of spore, gets the shape of bacterium when it gets the ideal temperature. This makes it more poisonous and adds a significant amount of toxins to the food. The disease is caused by eating different types of rice, especially rice cooked in the Chinese style. They play an important role in the spread of disease. In the hotels, the parboiled rice is dried at normal temperature for at least 24 hours. Spores left over

while cooking rice begin to develop. While serving to the customer, the rice is heated for just one minute and beaten eggs are added. This process of cooking destroys most of the toxins, but if the time before eating is too long, the little remaining toxins can again become a threat to human health.

5.8.3 Precautions

- a. Hotel and restaurant owners should either keep the rice warm for at least 1°C after boiling, or within an hour.
- b. Boil rice in small quantities as needed and should be kept in the refrigerator.
- c. Boiled or soaked rice should not be stored in hot conditions, especially between 15 and 50 degrees Celsius.

5.8.4 Self-Assessment Questions

Tick true or false.

- | | | | |
|---|--|------|-------|
| 1 | Vibrio cholera is rod-like shaped. | True | False |
| 2 | The optimal temperature of vibrio cholera is 13°C to 25°C. | True | False |
| 3 | The stools in cholera look like rice water. | True | False |
| 4 | <i>Salmonella gallinarum</i> and <i>Salmonella pullorum</i> cause disease in humans. | True | False |
| 5 | The incubation period of Salmonellosis is 12 to 24 hours. | True | False |
| 6 | <i>Salmonella typhi</i> caused typhoid. | True | False |
| 7 | <i>Bacillus cereus</i> produces endotoxin in the form of spores. | True | False |
| 8 | <i>Bacillus cereus</i> food poisoning is caused by uncooked rice. | True | False |
| 9 | Boiled and cooked rice should be stored hot | True | False |

Key for self-assessment questions

1. False
2. True
3. True
4. False
5. True
6. True
7. False
8. True
9. False

5.9 ENTEROBACTEROACAE

They belong to a family which does not have spores. They are small bacilli, and they naturally live in the food pipe of humans and animals. Among these, *E. coli*, *Salmonella* and *Shigella* produce diseases in humans.

5.9.1 E.coli

These bacteria are commonly found in the gastrointestinal tract of humans and animals and generally perform beneficial functions for the host (**figure 5.7**). They can survive in water and soil for several weeks. In waste, they can survive for more than a year at 50°C, but die in 15 to 2 minutes at 60°C. Although there are several potential causes of diarrhea, this is the most common one. These microorganisms may infect humans in three different ways. Some cause ailments of the heart, kidneys, and lungs by getting entrenched in internal organs.



Fig 5.7 E.Coli

Diarrhea in children: These days, this illness is quite crucial as it affects young children. Also, the mortality rate for the disease is significant. Sometimes this complaint happens to young people as well.

Seasonal diarrhea: It is sometimes severe. It usually occurs in children as young as four years old. It grows in children's intestines, causing nausea, vomiting, and diarrhea. Death occurs in two or four days.

Sources of diarrheal outbreaks: These viruses attach to the eating and drinking things from the hands of patients if not sanitized properly with soap after excrement. As a result, the items become polluted. Consuming this type of meal causes diarrhea in healthy people.

5.9.1.1 Symptoms of disease

A person feels the need to defecate three or more times each day. Stools frequently become quite loose. This is the earliest symptom of various infectious diseases, such as diarrhea, cholera, and others. As a result, it is not considered an infectious disease, but rather a symptom of these diseases. Dehydration develops, and if this shortage is not addressed in a timely manner, mortality occurs.

5.9.1.2 Precautions

Hands must be washed after defecation. During diarrhea, the child should not be starved, but appropriate food should be given to control the child's weakness. Try to breastfeed the baby. If this is not possible, the feeding bottle should be properly cleaned to ensure that all bacteria are killed. If the disease becomes severe, consult with the doctor immediately. As soon as the diarrhea starts, the patient should be given ORS, which is now accessible in most pharmacy stores, but a packet must be kept at home to be used as needed. It is, however, simple to prepare at home; the recipe is as follows.

Table salt ----- one pinch

Sugar ----- 4 tsp.

Water ----- 2 glasses

Boil the water and cool it, after this, dissolve salt and sugar in the water and add a little lemon juice would be good. This solution should be given to the patient at regular intervals. With this solution, the patient's body's water and salt imbalances will be fulfilled, and the patient will be safe.

5.9.2 Shigella

This is a type of bacillus that causes dysentery (**figure 5.8**). It is also called bacterial dysentery. The optimal temperature is 37°C. These bacteria can survive in tap water



Fig 5.8 Shigella

for four to six months, 2 to 5 months in sea water and 2 months in ice places. In milk, they grow rapidly. They live for several days in dirty clothes.

5.9.2.1 Symptoms of disease

Defecation is needed repeatedly. Blood is discharged with the stool. Stinging and spasms in the abdomen are felt. Although it is severe, it does not last long. In some

cases, it is fatal.

5.9.2.2 Mode of transmission

Dysentery is also caused by amoeba, but it is not as severe. They have long existence. In some cases, this amoeba enters the liver and causes liver abscess which is a dangerous and fatal condition. Precautions measures are the same as cholera.

5.10 TUBERCULOSIS

It is an infectious disease caused by a particular type of bacteria. It is known as tubercle Bacilli, which can affect any part of the body but commonly attack the lungs. When a person with this disease coughs, TB bacteria are released into the air. These bacteria enter the human body through healthy people's breathing or through food and drink (**figure 5.9**). Except for this, tubercle bacilli are released in the milk of infected women or animals. This disease is not inherited or familial. However, because children suffering from tuberculosis are born weak, they are more vulnerable to the disease than healthy children.

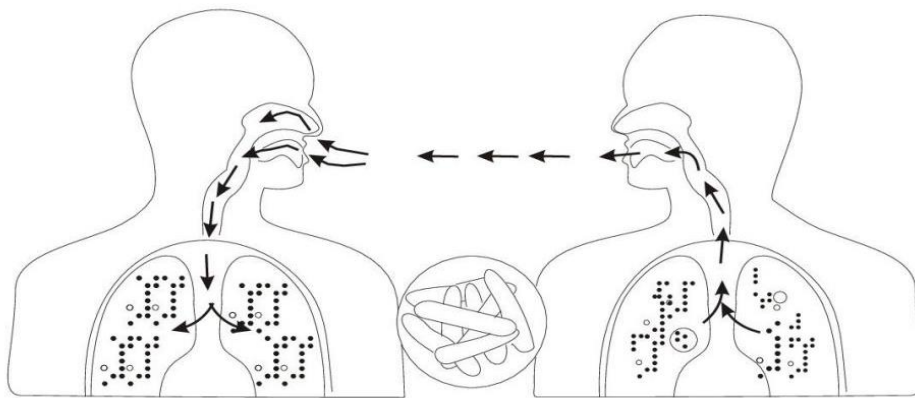


Fig 5.9 Tuberculosis transmission

5.10.1 Symptoms

The symptoms of this disease appear very slowly, that is why even after many months, the patient does not feel that he has suffered from this disease. First, the patient complains of a dry cough. After some time, a small amount of yellow mucus starts to be released. After a few days, a little amount of blood comes with yellow mucus. Furthermore, the patient feels continuously tired. In the evening, the patient develops a mild fever. The appetite fades, and the weight reduces gradually. The patient sweats so much at night that his clothes and bed sheets get wet.

5.10.2 Mode of Transmission

The following are factors that help in the spread of the disease:

- a. Consuming spoiled and contaminated food.
- b. Living in modest, dark, and damp houses.
- c. Presence of dust in environment.
- d. Physical weakness
- e. Anxiety worries and overwork.
- f. Drugs use
- g. Get married at a young age.
- h. Poverty and illiteracy.

The factors mentioned above in a TB patient reduce the immune system in the body, causing the disease to readily overcome the person.

5.10.3 Treatment and Prevention

When the disease's symptoms occur, the patient needs a lot of rest. Such a person should spend all his or her time in bed and avoid doing any kind of work. Diet plays an important role in the patient's recovery. Fortified foods enhance the patient's ability to resist disease. A patient's diet should contain milk, eggs, butter, fresh fruits. Sunlight and fresh air are also important for patients. The patient's room should be separate, and children are never allowed to enter.

The patient's utensils should be boiled in hot water and then washed with soap. The patient should not be allowed to swallow phlegm, by doing this, the disease spreads throughout the body. Spitting should be done using paper bags, which will be burned later. For prevention of TB, a vaccine known as BCG should be injected. In case of infection, treatment should be started immediately.

5.11 BRUCELLA

It is a bacterium which causes Brucellosis, also known as undulant fever and Malta fever. This bacterium is most often found in animals such as pigs, goats, and sheep, but it can also infect horses, rabbits, hens, dogs, and cats. A person becomes infected with Brucellosis by meeting such animals or consuming products made from them (**figure 5.10**). The disease is usually caused by drinking infected animal milk or consuming cheese made from such milk. Its incubation period is 3 weeks. In disease, fever increases gradually, weakness occurs, feels body pain and cold, the fever might sometimes become more severe and sometime reduces. This has happened for weeks or months. The disease takes two to three months, but

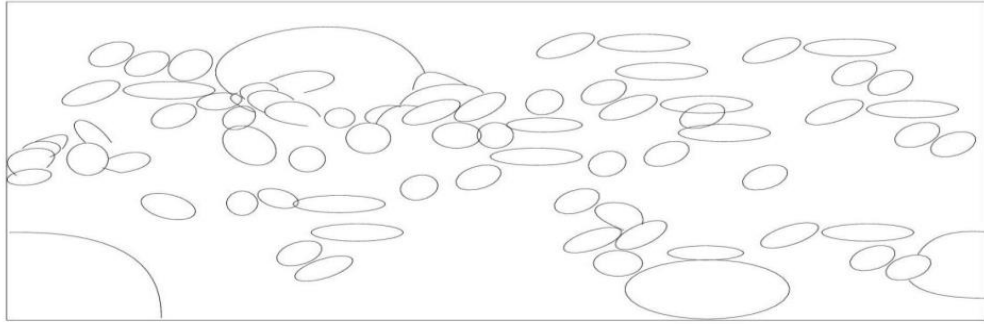


Fig 5.10 Brucella

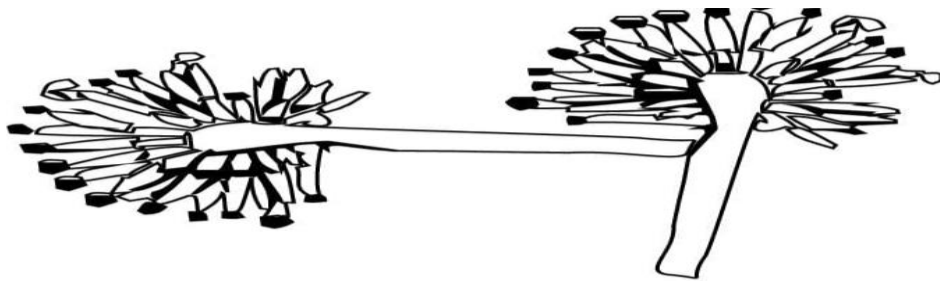
weakness might last up to a year.

5.12. MYCOTOXICOSIS

It is caused by poisoning fungi known as mycotoxins. A fungus in food creates toxic substances, causing mycotoxins. However, we will only discuss those that are directly related to the disease. Aflatoxin is the most important of all; therefore, it will be discussed first.

5.12.1 Aflatoxin

Aspergillus flavus and *Aspergillus parasiticus* are two forms of fungi that produce toxins known as aflatoxin (**Figure 5.11**). For example, it is produced in peanuts and causes illness when consumed by humans. Aflatoxins are extremely tough and



5.11 Aflatoxins

require prolonged exposure to temperatures above 100 degrees Celsius to be inactivated. Both forms of fungi are found in soil. They naturally feed on both living and dead plants and animals.

Aflatoxin mostly affects the liver. Liver tissues are damaged, or tumors develop in them. It causes liver cancer. Hundreds of people died in India in the 1940s because of consuming aflatoxin-laced food. Liver diseases are on the rise because people neglect to focus on aflatoxin control. They also use fungus-infected dry fruits.

5.12.2 Miscellaneous Mycotoxins

Ergot Alkaloids

It causes ergotism disease. It is caused by the mold *Claviceps purpurea*. The grains on which this mold grows, by consuming such grains a person gets ill and vomits. Diarrhea, impaired speech, loss of appetite, and death occur in severe cases.

Fusarial Toxins

Stored grains such as wheat and millet are poisoned by a fungus called *Fusarium* which causes intestinal infection. Initially, the disease's symptoms are mild, with vomiting and diarrhea, but after one to twelve months, the patient's condition gets worse, with rashes all over the body. They developed mouth and throat blisters and angina also occur. 50% of patients die because of it.

Yellow Rice Toxins

Penicillium, which creates mycotoxins in numerous grains, mostly rice, is responsible for the yellow color of rice. Toxins are produced in rice by three species.

- *Penicillium islandicum* is a fungus that causes liver failure.
- *Pencillium citricum* is a fungus that causes kidney failure.
- *Penicillium citreoviridin* causes paralysis of the nervous system-
- In Asian areas, the use of this yellow rice causes acute cardiac beriberi.

5.12.3 Self-Assessment Questions

Match the column.

Enterobacteriaceae	Symptoms of infectious diseases
Escherichia coli	Dysentery
Diarrhea	Undulant fever, Malta fever
Dehydration	Diarrhea
Shigella	Dehydration
Brucella	Food poisoning toxins
Mycotoxycosis	Escherichia coli, salmonella, shigella
Aflatoxin	Water deficiency
Ergotism	Complaint of angina
Diarrhea	Asparagus flavus, asparagus parasitic
Fusarial toxins	<i>Penicillium islenducus</i>
Yellowish rice toxins	Claviceps purpurea

Short Answer Questions

What effects might a bacterial infection have on public health?

1. Why is the second category of endotoxin more deadly for humans?
2. How many people benefit from their individual and collective actions in minimizing polio infections?
3. Enlist the primary sources of the spread of Botulism?

Key for self-assessment questions

Enterobacteriaceae	Escherichia coli, salmonella, shigella
Escherichia coli	Diarrhea
Diarrhea	Symptoms of infectious disease
Dehydration	Water deficiency
Brucella	Undulant fever, Malta fever, brucellosis
Mycotoxins	Food poisoning toxins
Aflatoxin	Asparagous flavus, asparagous parasites
Ergotism	Claviceps purpurea
Diarrhea	Dehydration
Fusarium toxins	Complain of angina.
Yellow rice toxins	Penicillium isleandicus

Practical

Draw a model highlighting the Food and Water borne diseases.

UNIT 6

DISEASES TRANSMITTED BY WORMS

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6.1 INTRODUCTION

The presence of parasitic worms in the human body is an infectious disease. Its effects are more common in hot weather conditions where the climatic conditions are suitable for their growth. The development of parasitic worms is more common in people who don't follow the rules of hygiene. In medical term it is known as *Ascaris Lumbricoides* and the diseases associated are known as ascariasis. These worms are usually grown in small intestines and their growth goes through different stages. The female lays egg on water or soil that enters in body through our food. In rural and urban areas of our country, there is poor management of waste and sewage drainage. Moreover, hygienic practices are not followed individually leading to the spread of communicable diseases such as hook worm disease. Infected individuals suffer from minerals as well as vitamin A deficiency that result in night blindness. The poisonous material present in the worm results in typhoid, itching, vomiting, diarrhea, constipation, swelling of face and intestine. It also results in bronchitis and anemia in children. In this chapter, information about worm diseases and their prevention will be explained in detail. By following those prevention measures can be taken for control and treatment of infected people.

6.2 OBJECTIVES

By reading this unit you will be able to learn:

1. Types of worms, their shapes and growth.
2. Once the effects on the human body, symptoms, and diagnostic methods are understood, timely treatment can be administered to the patient.
3. The spread of this disease can be prevented by cleaning items used by infected individuals.
4. Being aware of preventive measures for worm diseases and adhering to hygiene guidelines can contribute to the establishment of a healthier society.
5. You can take measures to avoid this disease by adopting an effective method of waste disposal.

6.3 COMMON ROUND WORM

It is the most common type found worldwide. It is especially common among people in hot weather countries who do not follow the rules of hygiene. This infectious disease is most found in children under the age of five. Its scientific name is *ascaris lumbricoides* and diseases associated are known as ascariasis.

Worms that are fully developed are present in the small intestine of the human body. They resemble Earth worms in appearance. These are the biggest parasite present in the human body. They are cylindrical in shape and have pointed edges on both sides. Mouth is present on anterior end (see figure 6.1). A specific irritating substance is present in their body that is known as carace.

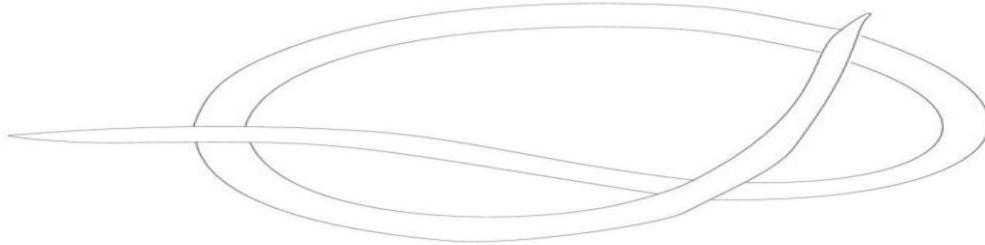
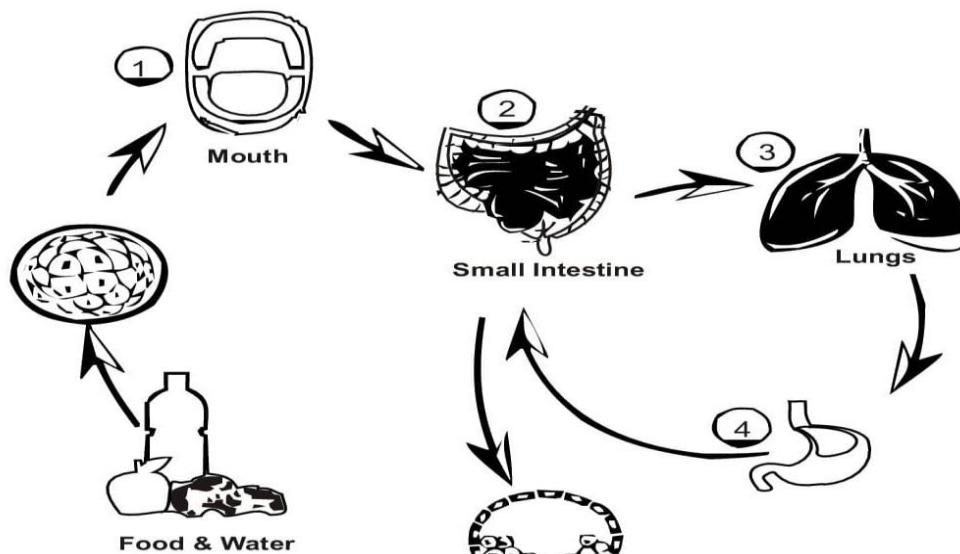


Fig. 6.1 Common round worm

6.3.1 Size

Length of male worm ranges from 15- 31 cm and diameter is 2-3 mm. Female worms are longer and stronger than male worms. Female worms lay 200,000 eggs daily in human gut that excretes out through feces.



6.3.2 Lifecycle

When the egg-containing waste of the female worm is on the ground, the first form of the worm present in it is the larva which later converted in the form of egg. These eggs enter the human body, the larva come out of the egg and enter the blood through the intestines. After passing through the liver and lungs, it goes back to the intestines where its development is complete. After full development, the female worm lives for about two months before starting to lay eggs again (Figure 6.2).

Infection begins when the ascaris eggs enter inside the human body. These eggs enter the body in different ways for example: Consuming raw vegetables grown on land having worm waste. Apart from this, disease can be caused by using water contaminated with such waste. After touching the contaminated soil, egg stick to your fingers and goes directly in body via mouth. Dirt particles containing worm eggs can also cause infection through eatables.

6.3.3 Symptoms

- a. It increases the chances of Protein Energy Malnutrition
- b. It causes vitamin A deficiency that results in Night Blindness
- c. Secretions from round worm can cause typhoid with high fever, itching, edema on face, severe abdominal pain, nausea, vomiting and malnutrition.
- d. These worms are active and keep moving from one part to another part of the body. Hence, it causes Jaundice, pneumonia, and appendicitis.
- e. Round worms can enter the stomach and excrete out via vomiting.

6.3.4 Diagnosis

Patients should consult the doctor if above mentioned symptoms start to appear. The disease can be diagnosed via microscopic examination of the patient's feces to see whether the eggs are present in the sample or not.

6.3.5 Precautionary Measures

- a. Wash hands properly before cooking and eating food.
- b. Use boiling water.
- c. Proper waste disposal
- d. Seek doctor immediately.
- e. Properly covered the eatables.

6.3.6 Self-Assessment Questions

Give short answers to the following questions.

- 1. Common worms are found in which part of human body?
- 2. How ascariasis starts in human body?
- 3. What are the symptoms of ascaris infection?
- 4. What are the side effects of common worms?

5. What precautions are recommended to prevent common worm infections?

Key for self-assessment questions

1. Refer to heading 6.3
2. Refer to 6.3.2
3. Refer to 6.3.3
4. Refer to 6.3.3
5. Refer to 6.3.5

6.4 HOOK WORM

Hook worm is also known as *Ancylostoma Duodenale*. They are also known as blood suckers. Their presence in children causes anemia. These types of worms are called duodenale. Geographically, it is widespread in all hot countries where soil temperature and moisture in air is suitable for their growth. It affects illiterate people who don't follow the rules of self-hygiene.

The released rhabditiform larvae grow in the feces or soil and after two molts it becomes infectious. A worm egg takes 8-10 days to become larvae. On contact with the human host, the larvae penetrate the skin and carried via blood stream to the heart and then to the lungs. They penetrate the pulmonary alveoli; ascend the bronchial tree to the pharynx. Then, it reaches in small intestines where they reside and mature into adults (**figure 6.3**). It can enter the human body through contaminated water and soil.

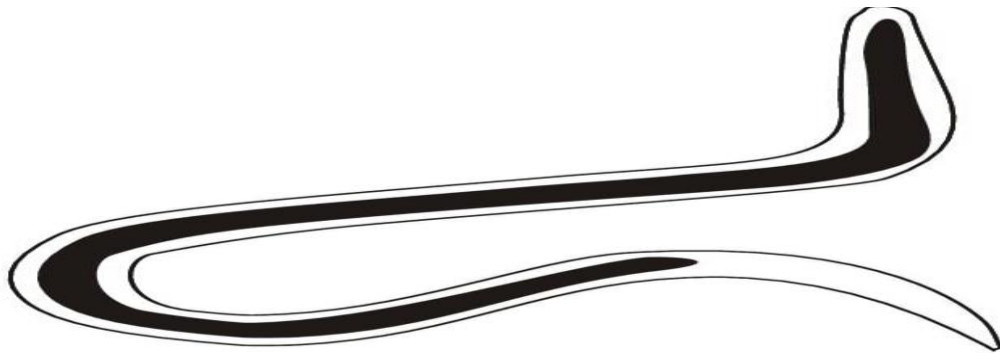


Fig. 6.3 Hook worm

6.4.1 Size and shape

Length of male worm ranges from 15-31 cm and diameter is 2-3 mm. Female worms are longer and stronger than male worms. Female worms lay 200,000 eggs daily in human gut that excretes out through feces.

6.4.2 Lifecycle When the egg-containing waste of the female worm is on the ground, the first form of the worm present in it is the larva which later converted in

the form of egg. These eggs enter the human body, the larva come out of the egg and enter the blood through the intestines. After passing through the liver and lungs, it goes back to the intestines where its development is complete.

After full development, the female worm lives for about two months before starting to lay eggs again.

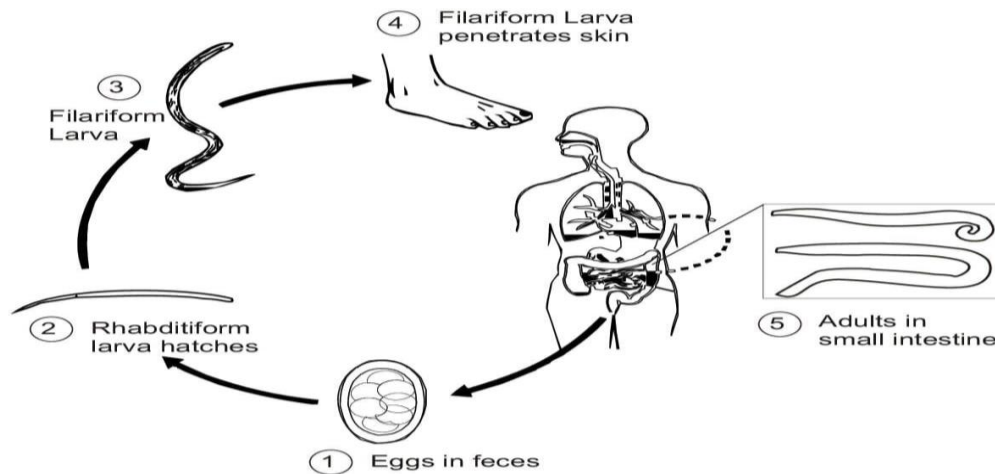


Figure 6.4 Lifecycle of Hook worm

6.4.3 Symptoms

- Fatigue
- Redness, Itchiness, and rash at penetration site
- Abdominal pain & Diarrhea
- Weight loss and lack of appetite
- Bronchitis and broncho pneumonia
- Iron deficiency anemia

6.4.4 Diagnosis and Treatment

The standard method for diagnosis of hookworm is by identifying hookworm eggs in a stool sample using a microscope. Complete blood count to check for anemia in which high count of white blood cells indicates the presence of infection.

6.4.5 Precautionary Measures

If hygienic principles are followed and proper precautions are taken, then the effects of worms can be avoided. Following are the precautionary measures:

- a. Proper management of wastewater drainage.
- b. Soil contaminated with feces should be treated with disinfectants.
- c. Avoid walking barefoot or other skin contact with such soil.
- d. Clean hands before eating and cooking food.
- e. Wash vegetables and fruits properly before consuming.

6.4.6 Self-Assessment Questions

Choose the best option.

1. How do hookworms penetrate the human body?

- a) From one human to another
- b) Contaminated soil
- c) By swallowing the fertilized eggs

2. Where larvae grow after eggs enter the body?

- a) 8-10days in soil
- b) In small intestine
- c) In feces
- d) In skin tissues

2. How larvae enter the body?

- a) From mouth
- b) Through skin
- c) Eating contaminated food items
- d) Grows in intestine.

3. When hookworms start laying eggs?

- a) After adulthood
- b) After larvae enter body
- c) After worm reaches a certain age
- d) Before entering intestine

4. What are the side effects of hookworms?

- a) Bloody diarrhea
- b) The digestive system gets damaged.
- c) Vitamin A deficiency
- d) Rashes on body, itching, anemia, stomachache, constipation

Key for self-assessment questions

- 5. a
- 6. b
- 7. b
- 8. a

6.5 THREAD WORMS

Thread-like worms are called “*Enterobius vermicularis*” and pin worms. They are present throughout the world and disease associated with thread worm is known as “enterobiasis”. Thread worms live in large intestines and lay eggs in anus. These eggs later hatch into the larvae, those who are fully developed are very small in size. Thread worms are white in color, spindle in shape with tapering on both heads (Figure 6.5).

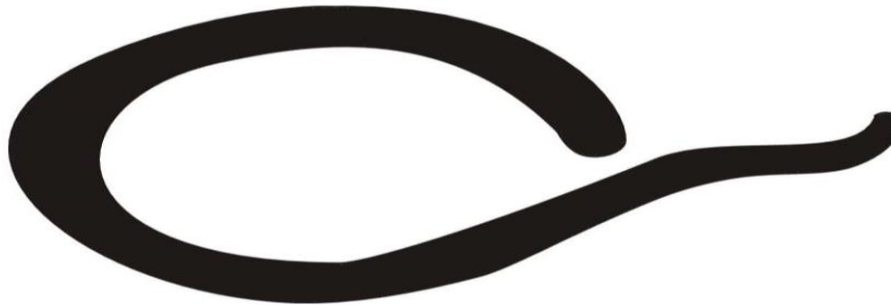


Fig. 6.5 Thread Worm

6.5.1 Size

Male thread worms are smaller than females. Male length is 2-5mm with 0.1-0.2 diameter. Lower part is curved while females are 8-12 mm in length and 0.3-0.5 in diameter. Unlike male worm, females are not curved rather straight. Thread worm eggs are colorless straight from one side and curved from the other side.

6.5.2 Life Cycle

Threadworms lay eggs around the anus that is the last part of large intestine. These eggs hatch in small intestines. After reaching adulthood, male worms enable females to lay egg then die. Then female enter in large intestine and remains there until eggs are fully hatched. Threadworms lay their eggs usually at night and this movement causes itching. Usually, eggs get stuck on fingertips while scratching and can be transferred to mouth.

If other people touch an infected surface, they can transfer the eggs to their mouth that can start this infectious disease.

6.5.3 Symptoms

- a. Itching in the anal area can result in eczema, redness and itching around the vagina.
- b. Moving from one place to other females can enter urinary tract.
- c. Female thread worms reside in large intestine or appendix and results in appendicitis.

6.5.4 Diagnosis and Treatment

- a. Examine near the anus to find eggs.
- b. Adult worms can be seen in bowel motion.

6.5.5 Precautionary Measures

1. Immediately treated the infected person.
2. Wash bed sheets and clothes with disinfectant
3. Wash your hands after going to the toilet or before eating.
4. Keep your fingernails clean and trimmed.
5. Teach children about personal hygiene.

6.6 WHIP WORMS

Disease associated with whipworm is known as *Trichuris trichiura*. They are present throughout the world. Hot sand and humidity are suitable for their growth. Whip worms live in the large intestine

6.6.1 Size: Adult worm looks like a whip. The anterior portion is subtle and posterior part is hardened like whip handle (**Figure 6.6**). Male worm is 3-4 cm in length and female worm length is 4-5 cm. Their eggs are brown in color. They are not infective on discharge

6.6.2 Lifecycle

The eggs are passed with the stool. Eggs mature in the soil and cause infection in two to three weeks. Once fertilized egg enters the body via water or food, it grows to larva and enters large intestine. They penetrate their anterior portion to the wall of intestine. After reaching adulthood the egg laying process begins.

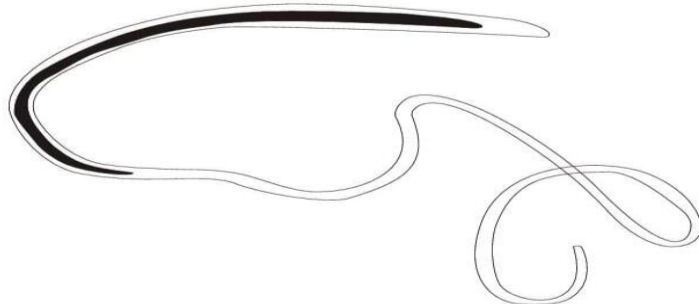


Fig. 6.6 Whip worm

6.6.3 Symptoms

- a. They are not harmful in the initial stages.
- b. They can cause inflammation in the appendix.
- c. People with heavy infection can experience painful bowel movement, bloody diarrhea and rectal prolapse.

6.6.4 Diagnosis and Treatment

- a. Microscopic examination of stool samples can be used to identify whipworms.
- b. Mebendazole can be used for the treatment of patients.

6.6.5 Precautionary Measures

- a. Avoid direct contact with contaminated soil.
- b. Wash all raw vegetables and fruits properly before eating.
- c. Use boiled water for drinking.

6.6.6 Self-Assessment Questions

Tick the right answer

- 1. **How do whipworm infections originate in the human body?**
- 2. The larvae enter the body.
 - a. Eggs ingestion
 - b. One person to another person
 - c. Eggs entering in tissues.
- 2. **Where does female whipworm lay eggs?**
- 3. in soil
 - a. around anus
 - b. in stool
 - c. sewage pond
- 4. **What are the side effects of movement of whip worm?**
 - a. itching and rashes on body
 - b. anemia
 - c. night blindness
 - d. diarrhea
- 1. **What are the diseases caused by female worm in large intestine and appendix?**
 - a. itching
 - b. abscesses
 - c. night blindness
 - d. appendicitis
- 5. **Diagnosis of whipworm can be done by?**
 - a. eggs in stool
 - b. eggs around anus and in stool

- c. worms on skin
- d. larvae in stool

Give short answers to the following.

1. Write a short note on the size of whip worm.
2. Write a brief note on the lifecycle of whip worm.
3. What are the side effects of infection caused by whip worm?
4. What are the methods used for the treatment and diagnosis of whip worm?
5. What are the ways to prevent worm infection?

Key for self-assessment questions

Answers

1. b
2. b
3. a
4. d
5. b

Answers

1. Refer to heading 6.6.1
2. Refer to 6.6.2
3. Refer to 6.6.3
4. Refer to 6.6.4
5. Refer to 6.6.5

6.7 GUINEA WORM

Guinea worm disease is caused by the parasite *Dracunculus medinensis*. Guinea worm is present in countries like India, Pakistan, South America, and Africa because temperature and climate of these regions are suitable for their growth and development. Adult guinea worm resides in tissues of arm, legs, and feet. Infective larvae are present in cyclopes. Adult worms are white in color.

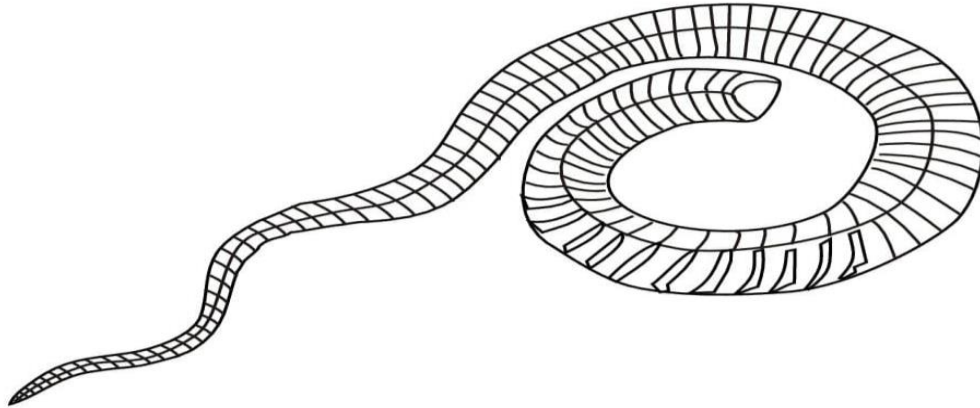


Fig. 6.7 Guinea Worm

(Figure 6.7).

6.7.1 Size Male is smaller than female. Length of male worm is about 3 cm while female worm is about 80 to 100 cm in length and 1.5mm in width

Their secretions are toxic and can cause blisters on skin.

6.7.2 Lifecycle It takes two hours to complete guinea worm lifecycle.

1. The human body is their first host. Adult parasites penetrate skin tissues.
2. Cyclopes are their secondary host. Embryo first completes the development stage and then becomes infectious for the human body.

Humans can get infection after drinking unhygienic water containing cyclopes. When cyclopes reach stomach, they are digested and release larvae which penetrate the host stomach and intestinal wall and move to the abdominal cavity where they mate. Male worm dies after mating. Pregnant female worm chooses the body of those individuals who frequently use water e.g., laundry man or the people carries water on their back. After reaching beneath skin, it releases secretion that causes blisters. These blisters eventually rupture and may cause ulcers. After direct contact with water, worms produce secretions that contain large amounts of coiled embryo. When an embryo enters water, it is again ingested through cyclopes and thus the cycle continues.

6.7.3 Symptoms

People do not usually have symptoms until adult female reaches the skin to release toxic substance which causes allergy, blisters, itching and burning sensation. Secretion released by the worm causes red spots on skin which later results in blisters, when blister ruptures it creates an opening for worm. Sometimes a secondary infection can happen in infected areas which can cause serious concern for a patient's health.

6.7.4 Diagnosis

Guinea worms can easily be seen on skin. White secretion containing embryo which is released from infected area can be seen under microscope.

6.7.5 Treatment

Skin can be washed again and again if large amount of secretions are produced. The best practice use in India is to remove the adult worm from the patient by wrapping or winding it a few centimeters every day while using a stick to do so at the skin's surface. Full extraction can take many days to weeks because the worm might be up to one meter long. To prevent breaking and leaving a piece of the worm behind, the procedure must be gradual.

6.7.6 Prevention

1. For prevention the most important thing is to break the cycle.
2. Drink only water from protected sources to stop cyclopes from entering one body to another.
3. Infected people should not help in storing water.
4. Water should be filtered properly.
5. Use medicine to kill cyclopes in water.
6. Infected body parts should be treated immediately.

6.7.7 Self-Assessment Question

1. Give short answers for the following.

- a. What are the side effects of toxic secretions of worms?
- b. How do embryos exit from the body?
- c. How guinea worm extracted from body?
- d. How to break the guinea worm cycle?

2. Fill in the blank

- a. Adult female guinea worm present on _____ of arms, legs, toes, and feet.
- b. Secretions of guinea worms are _____
- c. Infection of guinea worm starts when _____ enters inside human body.
- d. Guinea worm reached puberty in _____
- e. Poisonous secretions of guinea worm cause _____ on human body.

Key for self-assessment questions

Answers

- a. Refer to 6.7.3
- b. Refer to 6.7.4
- c. Refer to 6.7.5
- d. Refer to 6.7.6
- e. Refer to 6.7.6
- a. Tissues
- b. Poisonous
- c. Cyclopes
- d. Abdominal cavity
- e. Blisters

6.8 GIARDIE LAMBLIA:

Intestinal giardiasis is the most common disease caused by *Giardia Lamblia* worldwide (**figure 6.8**). Unencrypted parasites are present on the upper portion

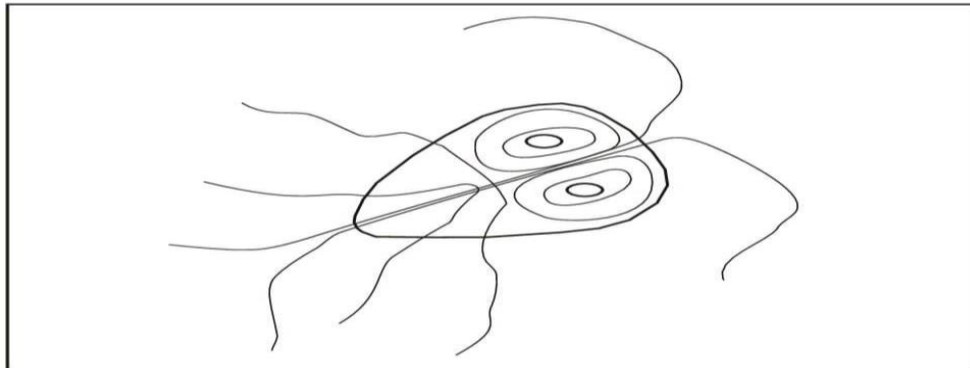


Figure 6.8 Giardie Lamblia

(jejunum) of the small intestine. They are rarely present in waste material but can be seen in case of diarrhea.

6.9 CYSTS

Cysts are a type of worm. They are oval and their length is 12mm and width is 7mm.

6.9.1 Life cycle

Encysted flagellate divided in human intestine they multiply by splitting in two in a process called longitudinal binary fission. They move to large intestine if

conditions are not suitable for their growth in small intestine and start encystation process and make a resilient wall with bacterial secretion and divide into two. If the cyst enters the human body the infection starts. In the human body, within 30 minutes cysts grow in encysted form and divide into multiples and start living in small intestines.

6.9.2 Symptoms

These cysts don't usually attack on intestinal epithelium rather busy in their functions. They can cause Diarrhea, fever, vomiting and allergy. In some cases, it can cause gastroenteritis.

6.9.3 Diagnosis and Treatment

Giardia cysts can be seen in fresh feces. For treatment take metronidazole for five days

6.9.4 Precautionary Measures

1. Wash your hands properly before eating.
2. Use boiling water for drinking.
3. Proper drainage of dirty water and feces
4. Timely treatment for giardiasis patient

6.10 TAPE WORM

Tape worm infection occurs all over the world. Their presence in the human body is very harmful. They have suckers on their head; have hook and a long chain of segmented bodies (**Figure 6.9**). They are bisexual.

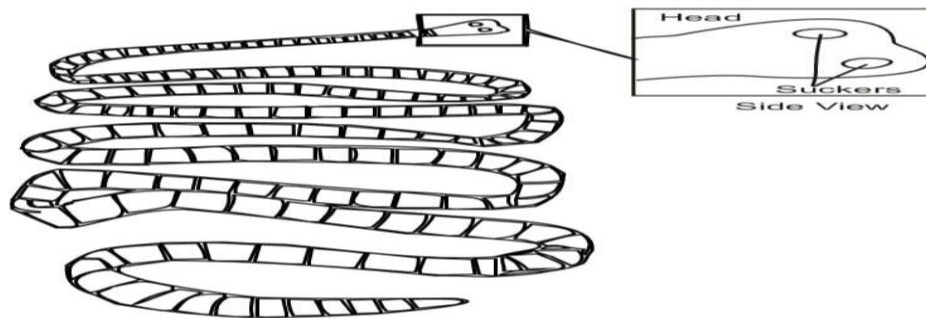


Fig. 6.9 Tape worm

6.10.1 Types of Giant Tapeworm

There are three types of tapeworms which can infect humans. All of them are caused by eating infected animal meat.

1. *Taenia saginata*
2. *Taenia solium*
3. *Diphyllobothrium latum*

Adult worms live in small intestines, they are white in color.

6.10.2 Size

Their length is five to ten meters which can grow up to twenty-four meters. Their body contains one to two thousand segments. These segments excrete out through feces. However, eggs of taenia can rarely be seen in feces.

6.10.3 Lifecycle

In their life tapeworms have two hosts: the first host is human body, and second host is animals. Their eggs present in human feces infect animals through fodder and food. Eggs burst in intestines and larvae enter meat where they start growth. In the human body this infection happens by eating infected meat which contains cysticercoid larvae. It grows in intestines and cycles continuously.

6.10.4 Symptoms

- Stomach problems
- Digestive disorders
- Anorexia
- Diarrhea
- Constipation

6.10.5 Diagnosis

- Eggs can be seen under a microscope.

6.10.6 Treatment

- One dose of niclosamide can be used for treatment.
- Four tablets are recommended for adults and for children two tablets in one dose.

6.10.7 Precautionary Measures

1. Avoid eating raw vegetables.
2. Cook meat properly and avoid uncooked meat.
3. Proper inspection of slaughterhouses
4. Proper drainage system
5. Timely treatment for the infected person.

6.10.8 Self-Assessment Questions

Give short answers to following questions:

- 1: How are cysts divided?
- 2: What are the side effects of infection caused by cysts in the human body?

- 3: How many types of tapeworms?
- 4: How did the infection of tapeworms start?
- 5: What treatment and precautionary measures should follow for tapeworm?

Key for self-assessment questions

1. Refer to 6.9.1
2. Refer to 6.9.2
3. Refer to 6.10.1
4. Refer to 6.10.3
5. Refer to 6.10.6 & 6.10.7

6.11 DWARF TAPE WORM

Dwarf tapeworm infection is also called *Hymenolepis nana*. It is most common in children living in temperate zones. In the human body adult worm lives in small gut. They are also found in rats. *H. Nana* is one of the smallest worms present in the human body.

6.11.1 Size

Its length is one to four cm with one mm diameter. They can be present in the intestine in large numbers. Worm head is globular in shape with suckers approximately there are two hundred segments in adult worm (**figure 6.10**). Their eggs are found inside feces.

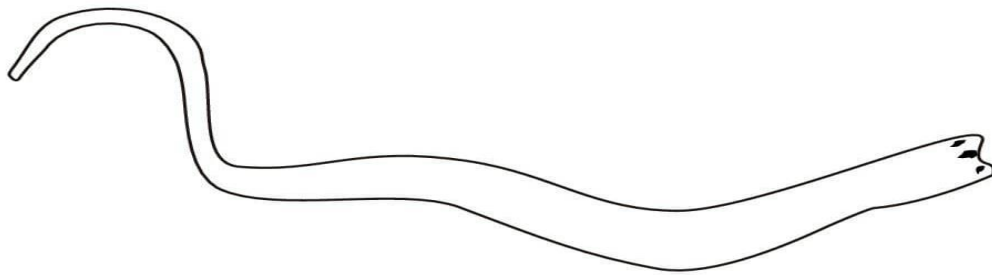


Fig. 6.10 Dwarf Tape worm

6.11.2 Life cycle

It enters the human body through waste of infected person. Embryo of dwarf worms is present in Gut where it penetrates and develops to larva and then enters the lumen of intestine and then gradually develops into adult.

6.11.3 Symptoms

Apparently, there are no visible symptoms but severe infection results in stomachache and diarrhea.

6.11.4 Diagnosis and Treatment

- Eggs of tapeworm can be seen in feces under microscope.
- One dose of nicodamid can be used for treatment of patients.

6.11.5 Precautionary Measures

1. Strictly follow hygienic practices
2. Wash hands before cooking and eating food.
3. Correctly dispose of animals and human's waste
4. Infected people should be treated on time.

6.11.6 Self-Assessment Questions

Fill in the blanks.

1. Adult dwarf worms are present inside _____ of human body.
2. Dwarf worms are present in _____ in large amounts.
3. An adult dwarf worm has _____ number of segments.
4. Embryo of dwarf worm penetrates the wall of _____ and gradually develops into adult.
5. Severe infection of dwarf worm results in stomachache and _____.

Key for self-assessment questions

1. Small gut
2. Intestine
3. 200
4. Gut
5. Diarrhea

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UNIT 7

COMMON DISEASES IN PAKISTAN AND THEIR TREATMENT THROUGH DIETARY MODIFICATION

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7.1 INTRODUCTION

Illness can be defined in many ways. It may be due to physical, mental, economic, social, and even spiritual reasons. Effects of illness vary individually. Specific illness consequences can be set on individuals, families and even the entire society. According to expert opinion illness is the absence of normal physiological function and physical disharmony. A sick person's daily life starts to lack order which makes him irritable. And he becomes dependent on others, which can make him lose his self-confidence and that is why many people with pronged illnesses are often depressed.

According to doctors, "disease" is a condition that can be diagnosed and treated, technically, chemically or by physical methods. Medical experts also use laboratory data to determine the nature and severity of the disease. These methods are used to identify the causes of disease such as bacteria, viruses and malfunction of cells or defects in metabolic conditions etc. There are many different types of diseases known to mankind but here we will only discuss about the most common diseases in Pakistan which are as follows:

- Diabetes
- Dehydration
- Goiter
- Obesity
- Fever
- Intestinal Disease
- Heat
- Stroke

7.2 OBJECTIVES

After reading this unit you should be able to:

- 1) Know about the common diseases prevailing in Pakistan.
- 2) Explain the reasons for the spread of these diseases.
- 3) Understand the diagnostic procedure of the abovementioned diseases.
- 4) Identify the order and amount of food required to manage diseases.

7.3 DIABETES

Diabetes occurs mainly due to the failure of production or use of insulin, which is a hormone and is produced by the pancreas. It is responsible for the use of carbohydrates to provide energy. In absence of this hormone blood sugar cannot be used and blood sugar level keeps elevating.

7.3.1 Reasons

Although this condition is very common, unfortunately its exact cause is still unknown, but there are some conditions which may contribute to the development of this disease.

1. **Family History:** A person is more at risk of developing diabetes if anyone of his parents, grandparents or blood relatives has diabetes.
2. **Age:** It is more common in people above 50 years of age.
3. **Obesity:** Obese people are more at risk of developing diabetes than normal people.
4. **Psychological Aspects:** A person who is over stressed is more likely to suffer from diabetes.

7.3.2 Symptoms

It has been observed that this disease appears gradually. And in most cases, it gets diagnosed when it has severely affected the patient. Most common symptoms of this disease are:

- Feeling thirsty very often
- Urinary frequency increases, especially at night.
- Mouth becomes dry.
- Weight loss
- Loss of vision or blurred vision
- Tingling or numbness in hands and feet
- Delayed wound healing.

This disease leads to many other diseases which can even result in patient's death. Women with gestational diabetes may give birth to over-weight children.

7.3.3 Diagnosis

- a. Urine examination:** A normal person's urine does not have glucose in it but is found in the urine of a diabetic patient which is determined through a urine test.
- b. Fasting Blood Sugar Test:** In this test blood sugar is checked after a person fasts for a whole night. If the blood sugar level is 99 mg/dL or lower than it is considered normal and if the blood sugar level is 126 mg/dL or higher than this indicates that patient is having diabetes.
- c. HBA1C Test:** This test measures blood sugar level of a patient over a period of three months. If the result of A1C is below 5.7% than it is considered normal, if

it remains between 5.7 and 6.4% than person is prediabetes and reading of 6.5% or higher indicates that person is diabetes.

d. Glucose Tolerance Test: In this test the patient is required to fast for the whole night and blood sugar is tested before and after the patient is given a glucose rich drink. The blood sugar level is checked after 1 hour than after 2 hours, and then after 3 hours. After 2 hours, if the blood sugar level is 140 mg/dL or lower than it is considered normal, and blood sugar level of 200 mg/dL or higher indicates that patient is having diabetes.

e. Random Blood Sugar Test: This test can be taken at any time without fasting. If the blood sugar level is 200 mg/dL or higher than the person is diabetic.

7.3.4 Dietary Modification

Diet plays an important role in this disease. It has been observed that diabetes can be controlled in the early stages through dietary modifications. The daily nutritional requirements of a diabetic patient mostly depend on the body weight of the patient. The daily requirement of carbohydrates, fat and protein of a patient can be estimated by total energy needs. Nutritionists recommend a balanced diet for overweight and obese diabetic patients that keeps the patient's weight 5 % less than their original weight range. Whereas for a patient with a normal weight, a balanced diet is recommended which contains an adequate number of calories to maintain a normal weight. A patient who has a normal or standard weight needs to meet his caloric requirements with carbohydrates, so food providing about 175 to 250 grams of carbohydrates be included in the daily diet.

A daily intake of one gram of protein per kilogram of body weight is also necessary for a diabetic patient, to meet his daily nutritional requirement, however, reducing the amount of fat in the daily diet is very important. Because they convert into ketones inside the body, and these ketones cannot be absorbed into the tissues at the same speed at which the ketones are made. As a result of which they begin to accumulate in the blood and urine which can be dangerous. Additionally taking vitamin B through diet is also important so that the carbohydrates in the diet are easily absorbed. Likewise, it is beneficial to include more of the vitamin A in the patient's diet.

Foods to avoid completely.

- a. Sugar and sugar products like cakes, biscuits, jam, sweets, chocolate pudding, halwa etc.
- b. Food with high glycemic index.
- c. Simple Carbohydrates

Foods that can be eaten in normal amounts:

Meat, fish, eggs, vegetables, cabbage, spinach, pumpkin, eggplant, tomato, radish, carrot, bitter gourd, okra, cheese.

Foods that should be eaten in small quantities:

White Bread, rice, pulses, cereals, etc.

7.3.5 Self-Assessment Questions

Answer the following questions.

1. Write down any major causes of diabetes.
2. Write any four symptoms that appear in a diabetic patient.
3. List out foods that are completely prohibited for a diabetic patient?
4. List out the food products which can be given in normal amount to diabetic patients.
5. List down the tests carried out to diagnose diabetes.

Key for self-assessment questions

1. Refer to 7.3.1
2. Refer to 7.3.2
3. Refer to 7.3.4
4. Refer to 7.3.4
5. Refer to 7.3.3

7.4 DIARRHEA

7.4.1 Dehydration

In terms of chemical ratio, water is 60% of the human body. This water resides in cells or extracellular spaces in the body. Having water in the body is very important for human health. Deficiency of water is commonly referred to as dehydration. It may be due to vomiting or diarrhea.

7.4.2 Types of Dehydration

Based on their symptom's dehydration can be divided into the following three parts.

Dehydration: A lack of water and electrolytes in the body either caused by diarrhea or vomiting.

Rehydration therapy: Fulfilling the body's need of lost water and electrolytes.

ORS (oral rehydration therapy): Water containing electrolytes is used to replenish or prevent the lack of water in the body due to diarrhea.

a. Mild dehydration: There may be four or fewer stools per day. Feeling thirst and urination is normal. Eyes are hydrated. Mouth and tongue are also hydrated and weight is also normal.

b. Moderate Dehydration: Following are the causes of mild dehydration:

- Four to ten stools a day
- A little bit thirsty
- Decrease in urine frequency.
- The eyes are dry and itchy inside.

- Mouth and tongue are dry.
- Heavy breathing
- Skin shrinks.
- The pulse rate is relatively fast.
- Weight is reduced from 2 to 100 grams.

c. Severe dehydration: If diarrhea and vomiting occur more than ten times a day it is categorized as severe dehydration. Following are the symptoms:

Very thirsty but unable to drink because of vomiting.

The physical condition is weak and emaciating.

Eyes are dry and sunken.

Mouth and tongue become very dry.

Heavy Breathing

The pulse rate is very fast.

Weight loss should be more than 100 grams.

In short dehydration occurs in the human body in diarrhea and there is a significant lack of electrolytes, which makes a person weak and emaciated. These conditions can eventually lead to death. Especially in middle age children.

7.4.3 Dietary Modifications

Dietary modification is brought according to the type of dehydration which are as follows:

a. Mild dehydration: Children with first-degree dehydration who are eating normally should continue with the same diet. During this time, liquid should be given as much as possible. Mother's milk, rice water, fruit juice, lemon water should be given to the baby according to his demand and at least five to seven times a day. ORS should also be given. If the child is under two years of age, give the child $\frac{1}{4}$ - $\frac{1}{2}$ cup of ORS after stool. Children of age two years or more, can be given a solution of one to two cups of ORS per day. If the child is vomiting, give the ORS solution ten minutes after each feed.

b. Moderate dehydration: In moderate dehydration continues to feed normally. It is better to take the patient to the hospital. and give ORS whose constituents must be as follows is as follows.

Items	Quantity
Salt (NaCl)	3.5gm
Baking Soda (NaHCO ₃)	2.5gm
KCL	1.5gm
Glucose	20gm
Boiled water	1L

c. Severe dehydration: Although in dehydration, the patient becomes extremely weak so in this condition it is necessary to take the patient to hospital for treatment.

7.4.4 Preventive Measures for Diarrhea

Children on mother's feed are protected from gastrointestinal diseases due to the proper and useful ingredients of mother's milk. It has been seen that mothers avoid giving milk to babies with diarrhea and reduce their daily meals. Giving milk to children with diarrhea should be avoided for a few hours only. Moreover, apart from milk, other soft and easily digestible foods such as yogurt and banana should be given to the children so that their energy is maintained, and the weakness can be prevented as much as possible.

7.4.5 Self-Assessment Questions

Answer the following questions?

1. What is ORS?
2. What is the chemical ratio of water in the human body?
3. How are patients categorized according to their level of dehydration?
4. What treatment would you recommend for diarrhea or dehydration?

Key for self-assessment questions

1. Refer to the information box.
2. Refer to 7.4.1
3. Refer to 7.4.2
4. Refer to 7.4.4

7.5 GOITER

In Pakistan, this disease is especially prevalent in the northern regions, especially Azad Kashmir and Baltistan.

7.5.1 Definition

In goiter, thyroid gland grows gradually in size. In some people it is not easily visible while in others it is visible from a distance. It grows in three stages.

7.5.2 Types of Goiters

- a. First Stage:* When it is visible during physical checkup or when patient is asked to move his neck upwards.
- b. Second Stage:* In this stage, the glandular swelling is visible in the patient without raising their neck.
- c. Third Stage:* Swelling can be seen from a distance. Goiter patients at this stage can get many other diseases like stunted height in children, slow growth, hands, and feet become weak and some children suffer from paralysis, there is a possibility of deafness and dumbness. The eyes squinted. There are chances of abortion in pregnant women.

7.5.3 Causes

This disease is prevalent in mountainous areas because the food in those areas is deficient in iodine. And iodine deficiency leads to this disease.

7.5.4 Treatment

Iodine requirement is fulfilled to treat this disease. This can be done in the following ways. Lipiodol Injection (this is usually iodine mixed with poppy seed oil) can prevent iodine deficiency for about 4 to 5 years. Use of iodized salt (iodine is added to salt) can eliminate or reduce the chances of this disease. Factories producing this salt are mainly located in Rawalpindi and Peshawar areas from where this salt is disseminated in other parts of the country. Thus, the government of Pakistan is supplying this salt in the areas where this disease is common i.e. in the Northern regions.

7.5.5 Self-Assessment Questions

Answer the following questions.

1. In which areas of Pakistan is goiter more prevalent? How will you diagnose a patient with Goiter?
2. What are the different types of goiters?
3. Which mineral deficiency causes goiter?
4. What will you suggest for the treatment of goiter?

Key for self-assessment questions

1. Refer to 7.5.1
2. Refer to 7.5.2
3. Refer to 7.5.3
4. Refer to 7.5.4

7.6 OBESITY

Obesity is a modern-day disease, which is directly related to an unbalanced diet. It is a disease more common in developed countries. In developing countries its victims mostly belong to the affluent class.

7.6.1 Definition

Obesity is the accumulation of excessive fat in the body. Medical experts established standards of weight according to age and height, if the weight is more than 20% of this standard, then it will be considered obesity. In such a condition, treatment becomes necessary.

7.6.2 Reasons

Obesity occurs only when energy intake is more than expenditure.

Following are the factors that lead to obesity.

- a. Age and Sex:* Generally, it occurs equally in both sexes, but it is more common in women who reach 45 years or above.

- b. *Economic condition:*** Most of the obese people belong to the affluent class.
- c. *Eating habits:*** Obese people have different eating habits. Some people have a habit of binge eating which makes weight gain inevitable.
- d. *Physical Activity:*** It is less common in active people and exercise regularly. In today's modern age, the means of transportation have become so fast and convenient that people have less opportunity to walk and exercise. This is the reason why office people and businesspeople tend to become obese relatively sooner than those having an active lifestyle.
- e. *Psychological factors:*** There is no longer any doubt that psychologically disturbed people do not eat in moderation, they eat more in any emotional state, and such people are more likely to be obese.
- f. *Glandular Factors:*** There is evidence that obesity can also be caused by glands malfunction especially pituitary and thyroid glands.

7.6.3 Complications Caused by Obesity

Apart from affecting physical appearance, fat gain also causes many types of diseases and physical disabilities.

- a. *Psychiatric disorders:*** Obese people suffer from a lot of psychological stress due to their body deformity, which makes them unable to control their eating habits.
- b. *Physical disability:*** The human body is designed in such a way that it is not capable of carrying excessive weight. Excessive weight gain can cause problems in knees, hip, and spine.
- c. *Digestive system disorders:*** Obesity must be related to digestive disorder in some way or other, for example, there is a possibility of diseases like diabetes, atherosclerosis, and gout.
- d. *Blood and heart diseases:*** People with obesity usually have high blood pressure and heart diseases.
- e. *Skin Diseases:*** Excess oil can cause acne breakouts. Excessive fat in some areas of the body can cause skin disease.
- f. *Accidents:*** Obese tend to slip more because of losing balance which can lead to accidents and injustices.

7.6.4 Treatment

In relation to the treatment of obesity, three basic principles should be followed. The first principle is that the patient should realize the importance of losing weight; another principle that must be understood while treating the patient is to explain the changes that may occur in his body due to hunger, exercise, and work. The third rule being to convince the patient that there is no food that reduces obesity rather the main objective is to minimize the food intake. It is important to develop and stick to a very strict eating schedule for successful treatment.

7.6.5 Dietary Modification

As mentioned earlier, obesity can be controlled by proper diet. Following are dietary recommendations for an obese person.

a. Energy: It is important to remember that a reduction in daily food intake does not lead to weight loss, rather, a lower number of calories in the daily diet leads to weight loss. If the patient does not have any other disease such as diabetes, the patient should be given 20 calories per kg of his body weight if the patient is engaged in simple daily activities throughout the day. Whereas such a patient who spends the day in a slightly strenuous activity will need 25 calories per kilogram of body weight.

b. Proteins: Proteins are very important for a diabetic patient as they help in muscle repair etc. It is not advisable to reduce its use. For every kilogram of a patient's weight, one gram of protein is required, so a 60-kilogram person will need 60 grams of protein per day.

c. Fat: Fat provides more calories per gram; therefore, it should be used in small quantities. This fat should consist of unsaturated fat rather than saturated or trans-fat.

d. Carbohydrates: To meet the satiety of food, carbohydrates that cannot be digested in the body should be added to the patient's diet. These are called non-digestible carbohydrates. And foods that contain high amounts of simple carbohydrates should be included in the daily diet in small amounts. For example, potato, sweet potato, rice etc.

e. Vitamins: Vitamin A and vitamin D deficiency may occur in patients with long-term consumption of low-calorie food so this deficiency should be addressed.

f. Mineral: During weight loss, one should consume a diet that contains relatively little sodium because less sodium absorbs less water in the body. While its high amount in the food traps the water in body. And water cannot be removed from the body quickly, which causes weight gain.

7.6.6 Importance of Exercise

Exercise is just as important as reducing junk food intake to eliminate obesity. Some people think that exercise makes you hungry. Thus, the consumption of food increases but this is not true. So, getting some exercise is very important.

Most obese people are used to a very comfortable life and if these people are asked to do moderate exercise, it can be very helpful in losing weight. Walking is also good exercise, but if a patient walks for one hour at a pace of three miles per hour, he will lose 300 calories. Therefore, if walking becomes a daily practice of a person, then he can be successful in controlling obesity. Other types of exercises also help in losing weight, no matter what kind of exercise it may be, regularity is very important.

7.6.7 Self Assessment Questions

1. According to standard of weight, if the weight is more than _____ of this standard, then it will be considered obesity.
A. 10%
B. 20%
C. 30%
2. What is the real cause of obesity?
A. Food intake is in accordance with the needs of the human body.
B. Exceeding the food requirement of the human body.
C. Food being less than the human body needs.
3. The amount of _____ increases in the blood of a patient with diabetes.
A. Red cells
B. White cells
C. Cholesterol
4. Types of carbohydrates should be included in the diet of a diabetic patient.
A. Easily digestible
B. Indigestible
C. That digest slowly

7.7 JAUNDICE

Jaundice is very common in Pakistan. It is usually found in backward areas of the city or in villages where there is no facility for clean drinking water. This disease can also become an epidemic.

7.7.1 Reasons

This disease is caused by a specific virus. This virus is entered into the body of a person either through infected food or drink, or if the used injection of a patient is used for another person.

7.7.2 Symptoms

The first symptom after the infection are appetite decreases, pain, and fever in the body, after a few days the eyes become yellow. When the disease is severe, the whole body turns yellow, and the urine also turns yellow. If it is not treated, it causes the liver to stop working and it can cause death.

7.7.3 Dietary Modifications

Diet is very important in the treatment of jaundice. Care should be taken to adjust the daily need of the patient depending on the appetite of the patient and the nature of the liver disorder during jaundice.

a. Calories: A person weighing 60 kg whose liver has been severely damaged and is unconscious requires around 1000 calories and diluted carbohydrates are provided to the patient through a nasal tube, or glucose is injected through the veins

so that it provides 1000 Kcal. In the case of moderate jaundice 1800 to 2100 calories are provided by various foods.

b. Protein: Patients with jaundice who are in coma are not given proteins and should only be given foods rich in carbohydrates. In severe jaundice, the patient needs about 40 grams of protein per day. These amounts of protein in the daily diet make the patient's malfunctioning liver cells enable to function properly. But if such a patient is given a protein rich diet, then there are chances of the patient going into coma. So, the patient should have such foods that contain small amounts of protein such as cereals include rice, biscuits, wheat, and millet bread, porridge etc. are included. When a jaundiced patient is recovering, it is important to increase the number of proteins in his daily diet. In this case, 60 to 80 grams of protein per day can be included in the daily diet. Foods that are rich in protein include all pulses, beans, eggs, fish, and all types of meat.

c. Fat: When the patient is in coma, he is not able to digest fat. Because his liver is so damaged that he is unable to absorb fat, he is not given fatty foods. However, a patient with severe jaundice is allowed to add up to about 30 grams fat in their daily diet. While in moderate jaundice, 50 to 60 grams of fat can be added to the daily diet.

d. Carbohydrates: A jaundiced patient requires a relatively high amount of carbohydrates to provide energy. A patient with coma is especially given the required amount through the intravenous route. As soon as the patient can drink, he should be given fruit juices, vegetable juices, sugarcane juice, and honey water are given, from which not carbohydrates is obtained, but electrolytes can also be obtained.

e. Vitamins: In all types of jaundice, the patient needs to get adequate amount of vitamins and minerals along with required calories.

7.7.4 Self-Assessment Questions

Encircle the following statements as true or false.

- | | | | |
|---|---|-------------|--------------|
| 1 | Urinary tract infections are usually more common in areas with poor sanitation and poor water management. | True | False |
| 2 | Jaundice is a disease that never spreads from one person to another person. | True | False |
| 3 | The first symptom of jaundice is excessive appetite. | True | False |
| 4 | It is very important to modify the diet of the patient with jaundice. | True | False |
| 5 | If jaundice patients in the condition of coma, he is not able to digest fat. | True | False |

7.8 INTESTINAL DISEASES

7.8.1 Definition

Gastrointestinal diseases refer to a group of diseases involving the gastrointestinal tract, namely the esophagus, stomach, small intestine, large intestine and rectum,

and the accessory organs of digestion i.e., the liver, gallbladder, and pancreas.

7.8.2 Symptoms

In this disease, the patient feels less appetite and feels burning in the stomach and chest.

7.8.3 Reasons

Carelessness in food consumption, especially excessive use of fat and spices, not eating on time. Mental worry and anxiety.

7.8.4 Dietary Modifications

Diet plays an important role in intestinal disease. Food should always be eaten at the right time. One should try to avoid chili and spices. Soft food, especially milk, porridge, rice, etc., should be used. Apart from this, the medicine prescribed by the doctor should be used; the use of jelly, potato, banana biscuit etc. will be appropriate. It would be more appropriate to follow the following schedule until the disease is cured.

- a. **Breakfast:** porridge, a glass of milk, an egg with bread or plain wheat roti and tea should be used.
- b. **Between breakfast and meal:** A glass of milk and a few biscuits Eat.
- c. **Lunch:** Use rice or bread and boiled meat, fish, or poultry.
- d. **Evening Tea:** Tea and Biscuits
- e. **Dinner:** Same as lunch
- f. Consume about one liter of milk at regular intervals a day.

7.8.5 Self-Assessment Questions

Answer the following questions.

1. Define intestinal disease?
2. What are the symptoms of intestinal disease?
3. Discuss the relationship between dietary habits and intestinal diseases.
4. What diet would you recommend for intestinal disease?

Key for self-assessment questions

1. Refer to 7.8.1
2. Refer to 7.8.2
3. Refer to 7.8.3
4. Refer to 7.8.4

7.9 HEAT STROKE

It is usually common in Pakistan in hot summers mostly among people with more physical work such as among factory workers. This intensity of the heat affects water and electrolyte balance that causes this disease.

7.9.1 Reasons

Our body adapts to the internal heat of the body too in contrast to external heat. But there are some situations when the external heat becomes so high that the body cannot adapt to this condition and the condition of a person deteriorates. By walking

in the sun or working in factory, the heat begins to dissipate in the form of a sweat. As a result, after some time, the loss of electrolytes occurs, and the person becomes unconscious.

7.9.2 Effects of Heat Stroke

a. **Mild effects:** Initially the heart beats become slow, and the person starts to become unconscious. This is since the blood circulation in the brain and related internal organs decreases.

b. **Severe effects:** This condition is caused by dehydration, which causes drowsiness, heart palpitations, muscle spasms, and decreased urination. In other cases, sweat glands become ineffective. The heart beats faster. And the person gets out of breath.

The person becomes unconscious, shivering starts in the whole body and the temperature of the body becomes very high, 105, 106 Fahrenheit. Sometimes the kidneys stop working. If medical help is not provided in time, it can lead to death.

7.9.3 Dietary Modifications

If the temperature is high in summer, it is better to avoid the sun or work in the shade. keep drinking cold water or salted water at regular intervals. One should drink as much water and use salt as possible, and if possible, immediately put the person in a cool place. If an air-conditioned place is found, it is even better. Then the patient's body should be soaked in cold water or ice and should be fed with salt in cold water. Repeat this process until the patient's condition improves. Otherwise, take him to the hospital for medical help.

7.9.4 Self-Assessment Questions

Answer the following questions.

1. Enumerate the causes of heat stroke.
2. How many stages of heat stroke are there? At which stage death can also occur.
3. What tips would you recommend preventing heat stroke?

Key for self-assessment questions

1. Refer to 7.9.1
2. Refer to 7.9.2
3. Refer to 7.9.3

UNIT 8

DIETARY MANAGEMENT IN VARIOUS DISEASES

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8.1 INTRODUCTION

In this unit, students will learn about the importance and therapeutic use of food in different kinds of illnesses. Food should be used as a treatment for any disease, but it must be balanced. For example, the use of salt by the cardiovascular patient is reduced or completely stopped. In this unit, you will only read about foods produced in different ways and related diseases. It is also clarified how to set up a one-day menu for these illnesses so that you can subsequently provide comparable food.

8.2 OBJECTIVES

We hope that after reading this unit you will be able to know.

1. The nature of different diseases and can suggest food for the sick according to his illness.
2. Can set a day's menu depending on the nature of different diseases.

8.3 USE OF FOOD IN DISEASES

Food is used to treat disease and provide satisfaction. But sometimes, the use of diet is done for the treatment of disease and then it plays a very important role in it. Physical, cultural, and social factors are involved in the selection of food, but if a person is ill, he faces more difficulties. The patient does not appreciate using these foods because they are neither pleasing to the eye nor delicious in taste due to physiological reasons.

Food cannot be absorbed because of general complaints such as nausea, vomiting, and abdominal pain. Similarly In case of diarrhea, the body cannot effectively absorb nutrients, which causes dehydration, which in turn causes weight loss and improper nutrition. Similarly, during fever, the rate of metabolism increases and thus increases the need for energy, protein, and vitamins. In this case, if someone is suffering from disease like diabetes, remember to raise or decrease a certain amount of nutrient. Let us first examine the goals of disease treatment through diet.

1. Maintain a balanced diet.
2. Replenish any nutritional deficiency. For example, fulfill the requirement of protein and vitamins.
3. Losing or gaining body weight using energy dense foods.
4. Using one or more nutrients according to physical capacity.
5. Optimizing the body or any of its organs through blend or low energy foods.
6. Increase immunity in the body against infections. According to the patient's requirement, dietary changes are made. Include the following:
 - a. Consistency
 - b. Texture
 - c. And the amount of energy or the amount of nutrients such as sugars, carbohydrates, sodium etc. mostly require modification.

A modified diet is defined as a diet that is altered by changing food consistency or nutrient content or by including or eliminating specific foods. It is also called a therapeutic diet.

8.3.1 Prescribing Food

As you know, doctors prescribe different types of medicines for different diseases, similarly the other nutritional requirements are also different in each disease, Prescribing diet is the duty of nutritionist, but due to lack of nutritionists in our country, this work is also being mostly done by doctors and nurses.

Dietary requirements are modeled after patient identification, as in patients with heart diseases, salt intake is reduced for a short period of time or for long period of time. After assessing the nutritional requirements, the doctor also suggests the form and method of giving the food. For example, should the food be given in liquid, semi-liquid, or solid form? Other may be given by tube or given by mouth. All these details are given in the next section.

8.3.2 Self-Assessment Questions

Read the questions carefully and mark as true or false.

- | | | |
|--|------|-------|
| 1. Diet is used according to the diseases. | True | False |
| 2. The main goal of diet therapy in any disease is to provide maximum comfort to the body or any of its organs through low energy foods. | True | False |
| 3. In our country, for the treatment through diet, it is not necessary to change its texture and consistency. | True | False |
| 4. Nutritionists in our country suggest what type of diet should be given in which diseases. | True | False |
| 5. Diet is given in different ways and depends on the nature of the diseases. | True | False |

Key of self-assessment questions

True

1. True
2. False
3. False
4. True

8.4 DIFFERENT WAYS OF FEEDING IN DISEASES

Feeding a patient in a disease is determined according to the nature of the disease. For example, if a person cannot take food by mouth, they are fed through a tube. There are many methods of feeding which are determined after identifying and observing the condition of the patients.

Let's read about it in detail. When consuming food, any of the following four methods are used. See **figure 8.1** below followed by explanation.

PARENTERAL AND ENTERAL NUTRITION

PARENTERAL NUTRITION

Feeding intravenously, by passing the usual process of eating and digestion.

(A) Feeding through the central vein

(B) Feeding through peripheral veins

ENTERAL NUTRITION

Liquid supplemental nutrition is either taken by mouth or is given via a feeding tube.

Nasal or oral feeding tube terminates at, either:

(C) Stomach (Nasogastric)

(D) Duodenum (Nasoduodenal)

(E) Jejunum (Nasojejunal)

(F) Feeding tube that lead through an artificial external opening into the stomach (Gastrostomy)

(B) Feeding tube that lead through an artificial external opening into the small intestine (Jejunostomy)

8.1 DIFFERENT WAYS OF FEEDING IN DISEASES

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8.4.1 Enteral Oral Feeding

As far as possible, the patient is advised to take food by mouth. Sometime this also requires the help of another person, for example, if the patients cannot sit or use their hands, another person helps to feed them.

8.4.2 Enteral Tube Feeding

Patients who cannot chew food easily, but their digestive system works properly, then the tube is used. For example, the tube is used in the surgery of mouth, nose, and throat diseases.

8.4.3 Parenteral (peripheral vein feeding)

If the patients cannot take food properly and their digestive system does not work properly, then in such a case the food is given intravenously. These methods can be easily used for short periods of time and consist of intermittent, dextrose, amino acids, vitamins, and mineral solution administered through peripheral veins.

8.4.4 Total Parenteral Nutrition

If the nutritional requirement of the patient is higher and needs to consume food during treatment for adequate support, then a special large vein is used. It is a special surgical procedure that uses a special nutrient-rich solution that is commercially prepared by nutritionists to suit the disease.

Next section of this unit will discuss only the various foods that are prepared at household level but vary in nature.

8.4.5 Self-Assessment Questions

Fill in the blanks.

1. After the disease, _____ is known as to suggest food.
2. Feeding by mouth also sometimes requires the assistance of _____.
3. _____ is used in the operation of mouth or nose and throat disease.
4. If the patient cannot take food properly or their digestive system and absorption do not work properly, the food is given by _____ methods.
5. A food solution is prepared at the _____ level through the veins.

Key for self-assessment questions

1. Identification
2. Others
3. Tube
4. Intravenous
5. Commercial

8.5 DIFFERENT TYPES OF DIETS

In any disease it is first ascertained how food should be given so that it can be easily digested and absorbed by the body. What kind of diet should be made which can be easily digested during the treatment and the patient's nutritional requirement can also be met.

In this section of unit, you will read in detail about the consumption of various processed foods and the diseases associated with them.

8.5.1 Liquid Diet

Liquid foods are easily absorbed by the digestive system at body temperature. These foods are usually given to patients with diseases who cannot chew food or in which the patient has had an operation. This diet is given to the patient five or six times a day. Liquid foods are usually given for a short period of time and the patient

who improves slightly is given soft foods. But while preparing liquid foods should keep in mind that it should be balanced. In case of a particular disease, its nutrition or nutrients are modified. These foods are given to various diseases such as diarrhea, fever, or toothache.

Liquids diet has been divided into 2 types.

1. ***Clear liquid diet***

2. ***Full liquid diet***

Clear liquid diets include tea, coffee, strained fruit juices, soup, lassie like items that can be easily drunk. Such a diet is given for a very short period such as 24- 48 hours and given after severe vomiting, diarrhea, or post-surgery. The main purpose of giving this type of diet is to maintain the water and electrolytes balance in the body and the patient does not feel thirsty. Soup and fruit juices contain sodium, potassium, and some carbohydrates. These foods are low in protein and fats. When these foods become easily digestible, soft diets are also given and when the patient is fully recovered, solid diets are used.

Let us now discuss in detail a disease related to fluid diet, what type of diet is recommended for such a disease and what should be included in a day's menu.

Dysentery

Dysentery has two types.

1. Bacterial dysentery
2. Amoebic dysentery

It has constant suffering from dysentery due to ulceration of lower parts of intestines. Other types of dysentery are caused by shigella and Salmonella. There are three types of diarrheas one is watery diarrhea, second is bloody diarrhea and thirdly is persistent diarrhea. Diarrhea of any kind causes a loss of water and salts in the body and the patient may become weak. In children, if dysentery persists for a long time, it has very dangerous consequences.

1. ***Dietary management:*** During dysentery a first fluid diet is recommended, for example fruit juices, lemon water, soup etc. **If the condition is very severe and vomiting is also done, in such cases the doctor will inject glucose.** Milk, tea custard etc. can be given to patients as soon as the disease has progressed. In case of severe dysentery, the following few points should be kept in mind.

- a. The patient should rest as much as possible.
- b. Maintain water balance in the body.
- c. To have proper treatment.
- d. For the first few days only take glucose or ORS. After that chicken soup, vegetable soup, yogurt, tapioca pearl, jelly, thin porridge can be consumed. There is one day menu plan as follows:
 - **Pre-Breakfast:** One cup of seasonal fruit juice
 - **Breakfast:** After boiling the porridge, strain the water and add a cup of milk and sugar to taste.

- **Morning snacks:** One cup of milk
- **Lunch:** Strained vegetable soup, thin custard
- **Evening snacks:** Strained fruit juices and a milk made product.
- **Dinner:** Custard, One bowl of Chicken soup
- **Pre bed:** One cup of milk

8.5.2 Soft Diet

As you have already read, with the improvement of patients' condition, a soft diet is recommended.

Soft diet is of 2 types:

1. ***Soft foods with fibers:*** Soft diet differs from regular foods only that it can be easily digested without chewing. no special method is followed in their preparation. The following points are kept in mind to convert a normal diet to a soft diet.

- a. Meat, chicken, and fish are cooked until tender.
- b. The vegetable is cooked longer than usual vegetable.
- c. Soft and juicy fruit that can be eaten easily e.g., banana, peach, apple, watermelon, mango etc.
- d. Eat bread, biscuit etc. soaked in milk.
- e. All desserts that are soft e.g., porridge, custard etc. are included.

2. ***Soft food without fibers:*** Soft foods without fiber are nutritionally balanced but low in fiber. And they are soft in nature. These foods are given after liquid foods and before solid foods. They are used in different types of infectious diseases such as fever, any discomfort in the digestive system or after operations etc. Let's read in detail about a disease related to a bland diet without fiber. What will be its symptoms and which foods? And to describe how a day's menu is made.

Peptic ulcers: Peptic ulcers are of two types.:

- a. *gastric ulcer*
- b. *duodenal ulcer.*

In this disease, stomach enzymes called pepsin and bile salts are secreted in large amounts. These two illnesses manifest in the high-acid regions of the stomach and duodenum. Pepsin secretion and other enzymes are elevated in this illness. At the beginning of the disease, if the stomach is empty, there are pains in the upper part and complaints of vomiting, nausea, etc. also present. In addition to medication, patients with ulcers are advised to exercise and get maximum rest.

1. **Dietary management:**

The main purpose of following a diet during an ulcer is to:

- Help the wound heal.
- Prevent further tissue damage.

The use of foods with little impact on gastrointestinal secretion and low acidity is recommended. Alkaline meals will help to relieve soreness and decrease

gastrointestinal secretion and motility. Try to drink two to three kilograms of milk a day when having severe pain. They should drink 2-5 servings of milk at different times.

Soft foods, such as semi-cooked hard-boiled eggs, soft khichri, bread, butter, soft fruit, and boiled eggs, must be consumed if the pain is reduced and the patient is able to get out of bed after a week. Below is a list of some foods to think about when selecting these or related foods for the day. Milk and dairy products like pudding, custard, etc. pale tea.

Total calories: 2500 kcal

Pre breakfast: One cup of tea or one glass of milk with brown bread or biscuits.

Breakfast: One glass of milk with strained porridge

Half boiled egg or a small piece of fish And bread with honey and one cup of tea

One glass of yogurt lassi

Morning Snacks: One glass of milk or yogurt lassi with one and half biscuits.

Lunch: A piece of shredded meat, chicken, or fish, well cooked. Mashed potato 1 gram of groundnut, lentil, or chickpea yellow and well ground dal part or jelly.

Evening snacks: One glass of milk with bread, One glass lassi or one cup of coffee Well-cooked mincemeat or 2 sandwiches of chicken, cheese, and boiled eggs.

Dinner: If the hunger is not intense, try soft bread, a piece of fruit, or two pieces of bread and butter. If the appetite is high, the night menu can be like the lunch menu.

Pre bed: One glass of milk with one or two biscuits or rusk.

Apart from dietary restrictions, it is important for the patient to eat at the prescribed time and avoid harmful substances such as tobacco.

8.5.3 Solid Foods

Solid food is used after soft food. When the patient's condition improves or he recovers, solid food is introduced. Doctors sometimes recommend this type of food during an illness, but this recommendation is made only after the illness has been diagnosed. For example, in case of constipation, it is recommended to use a maximum of solid food. In such a diet, foods containing as much fiber as possible are used. Fibers, or cellulose, contribute to digestion and absorption of various nutrients. Such foods are easy to chew and digest.

The following ingredients are used in solid foods:

- Contains all vegetables, especially spinach, beans, cauliflower, radish, onion, turnip, carrot, beet, and durian.
- This includes fruits, especially guava, apples, orange, melons, watermelon, mango, banana.
- Shelled grains and vegetables.

- Consuming liquids such as water and lassi is also helpful.

Let us now discuss the details of the use of solid food during constipation.

Constipation: Constipation is caused by illness, but here we will discuss chronic constipation in detail. It causes obstruction of the colon and rectum. Complaints about colonic obstruction are usually due to intestinal muscle weakness, cramps or tetanus, hard stools, colonic hardness fiber and fluid deficiencies. Symptoms of urinary tract obstruction are often caused by irregular eating and bowel movements, physical or mental discomfort, and muscle weakness that facilitates bowel movements. In constipation, the stool becomes hard and difficult to pass, and the regularity, size, and shape of the stool will also change.

Human physical and mental freshness change and lose their motivation to work.

1. Dietary management: Together with nutrition therapy, there are various methods of treatment available if the reason for the constipation is a medical condition. But if the discomfort is caused by a colon obstruction, the diet will be adjusted accordingly, like described in section discussed earlier.

Total calories 2300 kcal

Pre breakfast: Fruit like orange, apples, pomelo etc.

Breakfast: One orange or half pomelo, Wheat/ maize / millet chapati or brown bread, One egg, jam, or jelly or one cup of tea or coffee.

Lunch: Vegetable curry or any pulses curry, Vegetables salad (carrot, tomato, radish)

Evening snacks: One cup of tea or one glass of milk with biscuits

Dinner: Meat/ chicken/ or fish curry, Chapatti, Salad, Fruit (apple, melon etc.)

8.5.4 Self-Assessment Questions

Answer the following questions with the most suitable answers:

1. What is liquid diet? Give dietary management for dysentery.
2. Define soft diet and explain its types.
3. What is a solid diet? Give dietary management to patients suffering from constipation.

Key for self-assessment questions

1. Refer to 8.5.1 and 8.5.1.1
2. Refer to 8.5.2
3. Refer to 8.5.3 and 8.5.3.1

UNIT 9

NUTRITION EDUCATION

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9.1 INTRODUCTION

Nutrition education can be defined as any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviors conducive to health and well-being. Nutrition education, in the opinion of specialists, can address issues related to nutrition. This chapter will cover nutrition education, methods for educating the public, role of the educator, and the duties of the nutritionist. The importance of nutrition education emerges as a guiding light toward better living in a world where lifestyles have changed at an unheard-of rate and dietary decisions have a greater impact on our total health than before. The goal of this chapter is to explore the different dimensions of nutrition education and show how it equips people of all ages with the knowledge and tools they need to make educated dietary decisions.

9.2 OBJECTIVES

By the end of this chapter, you will be able to:

1. Quickly give an overview of the course "Food and Nutrition" by the end of this chapter.
2. Use the examples to discuss food and its nutrients.
3. Refer to and discuss the advantages of listening or seeing.
4. Highlight the nutritional issues that can be resolved through nutrition education.

9.3 NUTRITION EDUCATION

Education about good nutrition, healthy eating practices, and the contribution of various nutrients to general health and wellbeing is part of the process of nutrition. The purpose of nutrition education is to equip people with the knowledge and skills necessary to make wise food decisions that will benefit both their physical and mental well-being.

9.3.1 Addressing Nutrition Related Problems

Taking care of nutrition-related issues requires a methodical strategy that considers each person's demands, way of life, and health objectives. The following actions can be taken to handle nutrition-related issues successfully:

1. Assessment

Consider the person's present dietary practices, medical background, lifestyle, and any health goals or concerns they might have.

Consider elements including age, gender, degree of activity, cultural background, and socioeconomic situation.

2. Goal Setting

Work together to establish attainable nutrition goals with the person. The SMART acronym stands for specified, measurable, achievable, relevant, and time-bound goals.

Goals can involve controlling your weight, controlling chronic ailments, increasing your energy, or changing your eating habits for the better.

3. Education

Offer individualized nutrition education depending on the learner's needs and objectives. Describe the significance of nutritional intake, portion control, and healthy food selections.

Give advice on how to read food labels, comprehend nutritional data, and make wise choices when going grocery shopping and eating out.

4. Meal Planning

5. Behavioral Change

Assist the person in developing a balanced and diverse diet plan that satisfies their nutritional needs. Think about their dietary restrictions, preferences, and lifestyle elements.

Promote the consumption of a variety of foods from various dietary categories to guarantee a varied intake of nutrients.

6. **Monitoring and Tracking**

Encourage the person to keep a diary of their food intake, portion sizes, and goal-related progress. By self-monitoring, one can become more conscious of one's eating habits and help pinpoint areas for improvements.

7. **Adaptation**

Review and modify the dietary plan as needed considering the person's progress and responses. Due to changes in physical activity, weight reduction, or other causes, nutritional demands may alter over time.

8. **Collaboration**

When managing complicated health problems or psychological aspects of nutrition, work in conjunction with other healthcare professionals, such as doctors, dietitians, or therapists.

9. **Long-Term Approach**

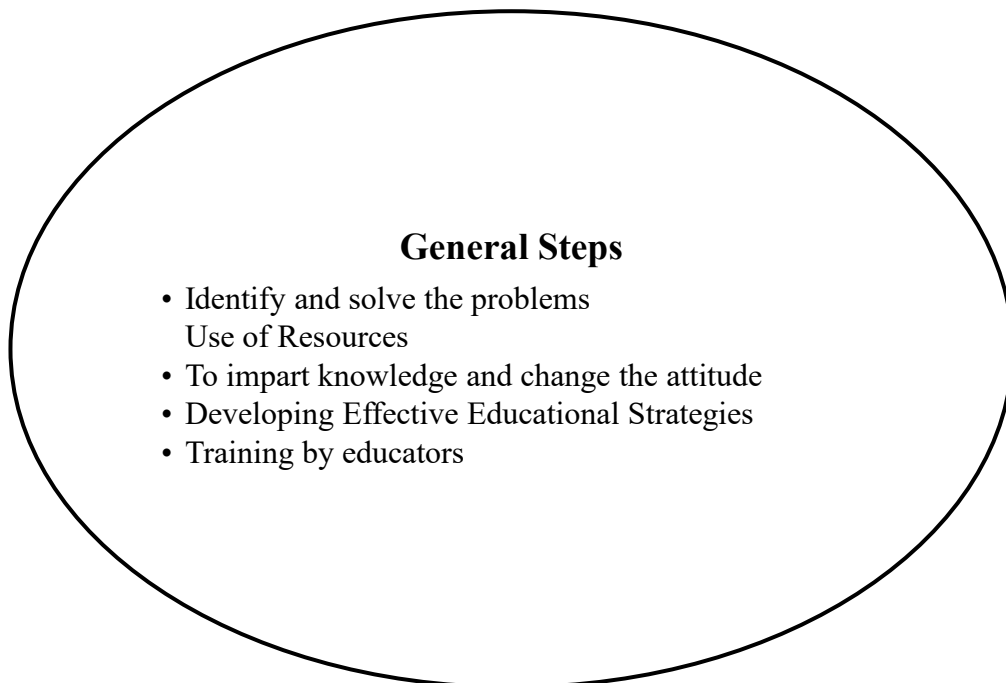
Highlight the importance of long-lasting changes above temporary ones. Concentrate on creating a positive relationship with food and improving gradually over time.

10. **Education and Empowerment**

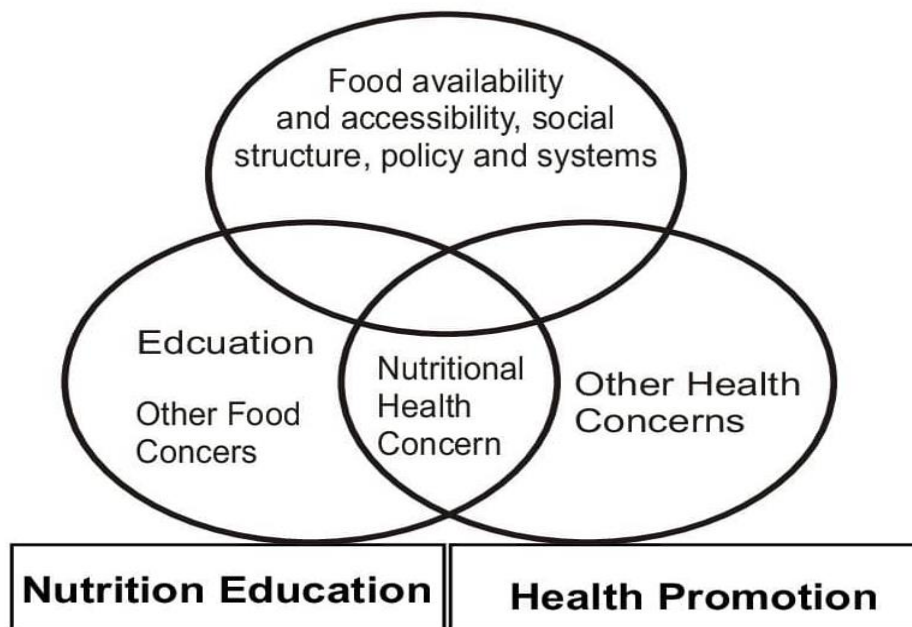
Provide the individual with the information and abilities necessary for them to independently make decisions about their nutrition. Encourage them to act as their own health advocates.

Nutrition Education is any combination of educational strategies, accompanied by environmental support, designed to facilitate voluntary adoption of food choices and other foods- and nutrition-related behaviors conducive to health and well-being. Many factors influence behavior; successful nutrition education uses a systematic approach and strategies that include a variety of activities to help the target group make.

Nutrition education is an essential component to improve the nutritional status of population and is crucial for the wellbeing of people in general. Poor dietary habits and lack of physical activity can be the main reasons for poor nutritional status among older adults. Likewise, pregnant, and lactating females need nutrient dense food in this phase of life. It is necessary to educate them to meet their dietary and nutritional needs.



Public Health Nutrition



9.3.2 Role of Nutrition Education

Our key aim must be to alter eating and nutrition-related habits for their betterment. In addition to education, educators must use nutritional counseling to influence students' eating patterns in the direction of healthy eating. It is essential to assess the nutritional intake of the individual to improve their eating habits by:

1. Changing way of thinking
2. Altering the attitude positively
3. Continuing good dietary practices

Some examples are as follows:

9.3.2.1 Malnourished children and dietary habits

Deleterious Dietary habits	Beneficial Dietary Habits
1. Delayed complimentary feeding. 2. Only breast feeding after 6 months of age. 3. Gender biasness – more focus on the boys rather than girls 4. Poor hygienic practices lead to poor health. 5. Less diet and liquid intake during diarrhea. 6. Overcooking of food causes loss of vitamins	1. It is necessary to start complimentary feeding between 4 to 6 months of age. Breast milk along with semi solids should be introduced. 2. Breast milk is a complete food. Both boys and girls need equal number of dietary components. Biasness should be prohibited. 3. Hygienic practices during transportation, cooking and storing should be maintained. Clean water should be used. 4. Soft diet and proper intake of water should be maintained during diarrhea. 5. To avoid the loss of Vitamin C from vegetables, overcooking must be prohibited, like wise water from the cooked rice should not be drained off.

Studying is a difficult job. It is often seen that renowned scholars do not seem to be good teachers. Despite having knowledge, lack of teaching skills makes them less effective. Likewise, our teachers have enough knowledge but due to discrepancy in skills make them less influencing.

Nutrition education is a course in which several ways can be used to teach this subject e.g., teacher can teach by lecture, discussion, trainings, videos, books, etc. Different ways of teaching are discussed in this chapter. Educating by means of lecture is one of the ways.

Discuss one topic at a time. Make the student learn about the topic and repeat it again and again for better understanding. Embed the social, cultural, and economic factors into nutrition education as most of the time these factors are neglected.

- a. Clear wording
- b. Simple and frequently repeated
- c. Consistent across all methods of delivery
- d. Maximum credibility of the source and the speaker
- e. Get attention and stand apart from other messages.
- f. Persuasive
- g. Distinctive
- h. Appealing and culturally relevant
- i. Always use audio-visual supporting materials
- j. Give practical examples of your theoretical knowledge.
- k. Discuss in the form of storytelling.
- l. Play games related to nutrition.
- m. Always listen to the problems of the students and try to solve them.
- n. Build self-confidence among the students.

Nutrition educators can address physical activity as well as nutrition.

- To encourage both active living and healthful eating.
- Given the increasing recognition that being less sedentary and more physically active decreases the risk of chronic disease and obesity and improves health.

9.3.2.1 Variety of approaches

Nutrition educators can embark on a wider variety of activities beyond the listed methods. The students are advised to explore more details about the listed methods, how these facilitate the nutrition educators in imparting nutrition education in the community and to the masses.

- a. mass media campaigns,
- b. lectures,
- c. group discussions,
- d. workshops,
- e. health fairs,
- f. newsletters,
- g. videos,
- h. brochures, and other print and audiovisual materials
- i. Collaboration

9.3.3 NUTRITION EDUCATOR

An educator is a specialist who focuses on educating people and communities about good nutrition, wholesome eating practices, and the significance of making educated dietary decisions. By disseminating precise and scientifically supported

information, educators play a critical role in enhancing health and preventing diseases connected to poor nutrition.

9.3.3.1 Qualities of good educator

- a. A good teacher is kind and soft hearted
- b. A good teacher understands the problems of students and tries to solve them.
- c. A good teacher knows the caliber of each student in the class and takes them along together.
- d. A good teacher always knows the fact that there is a difference between his/her knowledge and the student. So, it is necessary to start from the level of the student.

9.3.4 Self-Assessment Questions

Answer the following questions with the most suitable answers.

1. Define nutrition education. How will you address nutrition related problems?
2. What is the role of nutrition education by giving the most suitable example?
3. Who is an educator?
4. Write down the qualities of a good educator.

Key for self-assessment questions

1. Refer to section 9.3.1
2. Refer to 9.3.2
3. Refer to 9.3.3
4. Refer to 9.3.3.1

9.4 LEARNING METHODS & COMMUNICATION STRATEGIES

9.4.1 Pros and Cons of Widely Used Learning Methods

Method/Description	Pros	Cons
Lectures: Widely used; importance has decreased with an increased emphasis on participative methods.	Appropriate for developing background for course, presenting material to introduce a topic, or presenting material supplementary to assignments	Proceed at a pace determined only by the lecturer. One-way feedback. Strains short-term memory capacity of adults. Requires a special kind of self-confidence, performance.

Demonstration: For hands-on reinforcement or follow-up to lecture, discussion, reading etc.	Attracts and holds attention Easily understood Convincing Ties theory and practice together	Difficult for everyone to see. Learners must be present to benefit from the experience
Discussion An excellent way to cover essential points and allow interaction with individuals in a group; incorporating discussion into lecture allows for an increase in maximum length of time recommended to maintain effectiveness and listening	Can draw out conflicting opinions for constructive discussion; provides a memorable context for information	Lengthens the time needed to get a point across Can be difficult to stay on track Leader/facilitator needs specific skills: must be able to manage a group
Active, participatory methods Such as case studies, role plays, simulation, and games	Allow for participation Enable participants to learn general principles through interaction and a simulated "real life" situation Help bridge theory and practice gaps All group members can be involved	Require lengthy preparation. Require careful facilitation to benefit maximally. Demand time for processing and debriefing following the exercise. Clashes of philosophy and style among facilitators may result in difficult situations
Open Learning (Sometimes called distance learning) Allows for learning at a distance from the providing organization.	Self-directed, allows for flexibility in administration and participation Can be used by	Expensive to produce and buy. Need good discipline and time management skills with so little

May include use of recent technology	organizations with few resources for training	supervision and intervention provided. Learner is isolated - no group involvement, no group support, limited opportunity for interaction.
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9.4.2 Communication Strategies

9.4.2.1 Choice of media and multimedia combination

What is the media? The media are the channels of communication through which messages are transmitted. It is necessary to distinguish between two channels of communication, namely, face-to-face and mass media.

Face to face communication: Oral communication in the form of a face-to-face encounter may take place in two kinds of circumstances. The voice is the main organ of face-to-face communication, but the use of other support materials is highly recommended. These support materials can be printed, visual, and audio-visual. They reinforce the oral communication between the "educator" and his target audience.

Interpersonal Communication: Two people are brought together in a face-to-face situation, is of considerable importance in any strategy for public education. In fact, the most successful attempts to change nutritional habits have been based mainly on interpersonal communication used in conjunction with other methods. It was stated earlier that the aim of the intervention is to modify social communication about nutrition to change what people say about nutrition. The result of an intervention in nutrition education must therefore encourage interpersonal communication.

In what context can such an intervention take place? The most obvious time is during consultation in a health center. The health Officer takes time out to speak to his patient (or the parent of the patient), listen and help him to find a solution to his problem. Most people working in development programs are involved in interpersonal communication. Communication in a group situation has been the principal means of nutrition education for a long time. Communication in a group situation has improved because of field experience and scientific research.

The mass media: With mass-media communication, the transmitter and receiver are never in direct contact. The interaction is mediated through the visual image, print, or by a combination of these elements.

Radio diffusions use sound (music and words). The programs come in many formats, talks, debates, advertisements. For a long time, health education programs were limited to debates between journalists and medical experts.

Television uses sound, moving images and sometimes written text.

Newspapers can be used in communication projects if the aim is to mobilize a social class comprising opinion leaders and their social networks.

Posters can serve as a means of communication. The support material for a poster is the poster itself but may also be in the form of a T shirt.

Internet

9.4.3 Self-Assessment Questions

Answer the following questions with the most suitable answers.

1. Write down the Pros/Cons of widely used learning methods.
2. What is media? How can make a choice of media and multimedia?

Key for self-assessment questions

1. Refer to 9.4.1
2. Refer to 9.4.2

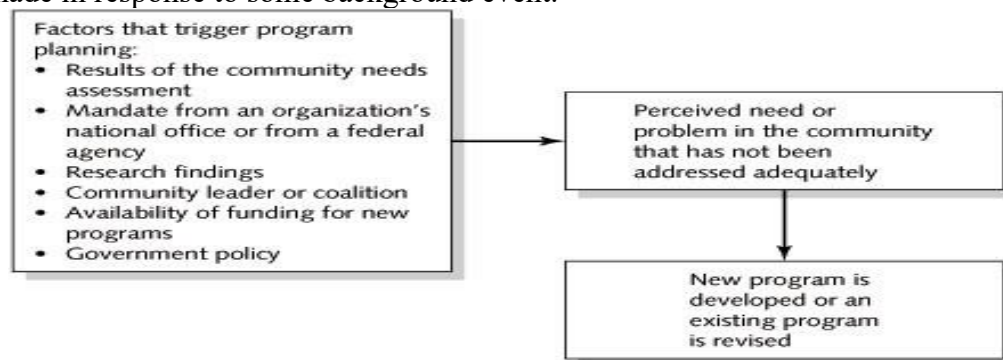
9.5 COMMUNITY BASED NUTRITION EDUCATION PROGRAMS

9.5.1 Introduction

Program planning is the process of designing a program to meet a nutritional need or fill a gap in services. The process of program evaluation is described, including why evaluation is important, who conducts the evaluation, how the findings are used, and how to prepare an evaluation report.

9.5.2 Factors that Trigger Program Planning

The decision to develop a nutrition program or modify an existing one is usually made in response to some background event.



9.5.3 Steps in Program Planning

- a. Review the organization's mission statement before developing or modifying a program.

- b. A mission statement is a broad declaration of the organization's purpose and a guideline for future decisions.
- c. If the match between the organization's mission and the program concept is good, then senior management will support the program.

Step 1	Review the results of the community needs assessment.
Step 2	Define program goals and objectives.
Step 3	Develop a program plan. • Design the intervention. • Design the nutrition education component. • Develop the marketing plan.
Step 4	Define the management system.
Step 5	Identify funding sources.
Step 6	Implement the program.
Step 7	Evaluate program elements and effectiveness.

9.5.4 Learning Across the Life Span

People of any age learn best if:

- They have the prerequisite knowledge.
- Content is broken into small pieces.
- They have an opportunity to practice what they have learned.
- The content seems relevant.

9.5.5 Developing a Nutrition Education Plan

The nutrition education plan outlines the strategy for disseminating the intervention's key messages to the target population. Key nutrition messages may be designed to change consumer behavior, as message. The nutrition education plan is a written document and includes:

Needs of the target population.

Goals and objectives for intervention activities

Program format

Lesson plans

Nutrition messages to be imparted to the target population.

Marketing plan

Any partnerships that will support program development or delivery.

Evaluation instruments

Developing a Nutrition Education Plan

A nutrition education plan is developed for each target group. At the systemic level, the nutritional education plan might properly be called a strategy.

9.5.5.1 Nutrition education to reduce CHD risk: case study 1.

The "Heart works for Women" program is a health promotion activity designed to help women reduce their CHD risk. The senior manager is responsible for

developing, implementing, and evaluating the intervention. Senior manager decides to organize intervention activities into two areas, smoking and nutrition, and each area is assigned to a different team. The manager designates a leader for each team. The community nutritionist first identifies the target population's educational needs by reviewing the data obtained during the community needs assessment and by conducting formative evaluation research.

Set goals and objectives: Develop goals and objectives for the program and use these to sketch a rough outline of the program sessions.

Specify the program format: The nutritionist now chooses a format for the program that suits the topic and the amount of information that must be presented. The program will consist of 90-minute sessions in which participants will set target dietary goals, try new behaviors, and assess their successes. The key strategy will be to seek small behavioral changes.

Develop lesson plans: The nutritionist now considers the instructional method and chooses to present the material in group sessions, knowing that participants can learn from one another. She must also decide whether to use existing educational materials or whether to design her own.

Case Study 1: Lesson Plans for the First Two Sessions of the "Heartworks for Women" Program

SESSION	TITLE	SESSION OBJECTIVES	INSTRUCTIONAL MATERIALS	LEARNING ACTIVITIES	NUTRITION MESSAGES
1	Getting Started	- At the end of the session, participants will be able to: - Describe the program's two goals and four objectives. - Describe five major risk factors for CHD.	- Participant information form - Description of course goals and objectives - Handout: "Is Homocysteine a Risk Factor for Heart Disease?" - Handout: "Recipe for Summer Salsa and Baked Pita Chips" - Brochure: "Get the Facts about Heart Health"	- CHD and nutrition knowledge pre-test - Handout: "Am I Ready for Change?" - Taste test = Summer Salsa and Baked Pita Chips (a low-fat recipe)	- Diets high in fat and saturated fat raise blood total cholesterol. - High blood cholesterol levels are a risk factor for CHD. - Low-fat cooking is easy.
2	Looking for Fat in All the Right Places	- Define four types of dietary fats. - Describe the major food sources of dietary fat. - Describe the major sources of fat in the typical U.S. diet.	- Handout: "Definitions of Fats" - Handout: "Dietary Fats Chart" - Handout: Goal sheet	- Dietary Fats Quiz - Completion of goal sheet: Reducing saturated fat intake	Choose low-fat foods more often than high-fat foods.

Specify the nutrition messages: Messages should convey a simple, easy-to-understand concept related to the topic. e.g., of a message would be to 'Choose lean cuts of meat.'

Choose program identifiers: The nutritionist chooses the program name, logo, an action figure, or a **tag line**, which gives the program its own identity.

Develop a marketing plan.

Specify Partnerships: The nutritionist establishes a partnership with a local grocery store chain to use one of its stores as the setting for one session on shopping for low-fat foods and reading labels.

Conduct Formative Evaluation: Focus group sessions to test the dietary messages and program instructional materials. Testing the print materials for reading grade level. Results of the formative evaluation are used to change and improve program delivery.

Designing Nutrition and Health Messages: Studies of consumer behavior suggest several ways of designing nutrition messages to grab consumers' attention...



Present information in a novel or unusual fashion. Use language that says to the consumer "Listen to this. It's important. "Use language that is immediate. Design messages that use verbs in the present tense and demonstratives such as this, these and here. Avoid using qualifiers such as perhaps, may, and maybe that express uncertainty. Use straight forward statements rather than tentative statements.

Implementing the program: After the program has been designed and tested, it is ready for implementation. The goal at this phase is to deliver the program as faithfully as possible. Keep a record of any unexpected problems so that a strategy for preventing them can be developed for future programs.

Enhance program Participation.

Ways to improve participation rates: Understand the target populations' needs and interests. Use evaluation research to improve the program design. Remove barriers to participation.

Implementing the program

Find ways to help participants see the immediate benefits of participating.

Schedule the activity at a convenient time.

Use incentives for participating.

Build ownership of the program among participants by using slogans, action figures, and logos to enhance the program's identity.

Evaluation: Evaluation can be used for different purposes:

To determine whether progress is being made towards meeting goals and if the goals are still appropriate.

To determine whether some elements of a program should be changed.

To identify ways in which interventions can be improved.

To pinpoint weaknesses in program content.

Conducting Evaluation: The evaluation is conducted to:

meet certain accountability requirements of a funding agency or senior management.

ensure that program resources are being used properly.

assess cost-benefit factors.

determine whether objectives have been met or whether priorities need to be changed.

How Evaluation Findings Are Used?

May be used to influence an executive or politician who has the authority to distribute resources and shape public policy.

May alert managers and policy makers to the need for expanding or refining programs.

May be applied to an immediate problem, and used by managers who are focused on the problem.

They may be used to shape policies and services beyond the scope of the original problem.

Who conducts evaluation? Evaluations may be conducted by program staff or outside consultants. The evaluator is responsible for all aspects of the evaluation from negotiating the evaluation focus to collecting data and preparing the final report.

The program evaluation process: The purpose and scope of an evaluation depend on the questions being asked about the program. It may focus on one specific program element, or it may be comprehensive and examine the design of the program, how it is delivered, and whether it is being used properly. Evaluation occurs across all areas of program planning, from design to implementation.

The Program Evaluation Process: The evaluation tools of the community need assessment are:

The health risk appraisal

Focus group discussions.

Screenings

Interviews

Direct assessments of nutritional status

Evaluation a Planning Tool: During program planning, evaluation occurs at each step.

Types of evaluation:

1. Formative
 2. Process
 3. Impact
 4. Outcome
 5. Structure
 6. Fiscal
1. **Formative evaluation:** Formative evaluation is the process of testing and assessing certain elements of a program before it is implemented fully. Managers develop program goals and objectives to determine its impact and effectiveness. They conduct formative evaluation to achieve a good fit between the program and the target population's needs, to develop appropriate nutrition messages, and to design a marketing plan.
 2. **Process evaluation:** Process evaluation is a measure of program activities or efforts--that is, how a program is implemented. Helps managers decide what services to provide, how to provide them, and for whom. In process evaluation, the evaluator examines the target population to determine how they were attracted to the program and to what extent they participated.
 3. **Impact evaluation:** Impact evaluation is the process of determining whether the program's methods and activities resulted in the desired immediate changes in the client. Might include variables such as: beliefs, attitudes, knowledge, decision-making skills, and self-efficacy.
 4. **Outcome evaluation:** Outcome evaluation is the process of measuring a program's effectiveness in changing one or more aspects of nutritional or health status. Variables might include health status, food intake, morbidity, and mortality. It is challenging because of the difficulty of determining whether a particular effect was caused by the intervention and was not due to some extraneous factor. Confounding factors might include unexpected events, such as a natural catastrophe, or certain characteristics of clients. It is designed to account for a program's accomplishments and long-term effectiveness in terms of a health change in the target population. Outcome evaluation measures can include *percentage (%) body fat, calcium intake, stroke prevalence, blood pressure*.
 5. **Structure evaluation:** Structure evaluation of personnel and environmental factors related to program delivery, such as training of personnel or adequacy of the facility.
 6. **Fiscal/efficiency evaluation** --the process of determining a program's benefits relative to its cost. There are two types of efficiency evaluation:

- a. **Cost-benefit analysis** - estimates both the tangible and intangible benefits of a program.

Costs and Benefits Considered in a Cost-Benefit Analysis of the "Heartworks for Women" Program		
TYPE	COSTS	BENEFITS
Direct	Personnel—salaries	Revenue from program
	Utilities (telephone, Internet)	
	Travel (to/from worksites)	
	Office supplies	
	Postage	
	Equipment	
	Instructional materials	
	Design	
	Printing	
	Promotion and advertising	
Indirect	Personnel—benefits	Increased exposure for the program and the organization within the community
	Rental of office space	
	Utilities	Reduced use of health care services by employees of participating worksites
	Equipment depreciation	
	Maintenance and repairs	
	Janitorial services	

- b. **Direct and Indirect costs** of implementing the program and everything is translated into a common measure, usually a monetary unit.

9.5.6 Communicating Evaluation Findings

Evaluation findings should be compiled into a final report:

1. **Front cover**
2. **Summary** - a brief overview of the evaluation.
3. **Background information** - places the program in context and describes what the program was designed to do and how it began.
4. **Discussion of results** - interprets the results and explores the reasons why a certain outcome was reached and how the program compares to similar programs.
5. **Conclusions, recommendations, and options.**
6. Once the report is written, you must decide how to best distribute it.

9.5.7 Self-Assessment Questions

Answer the following questions with the most suitable answers.

1. Write down the factors that trigger program planning.
2. Design a lesson plan for addressing CHD patients.
3. What are the steps involved in the program planning?
4. What are the main components of a nutrition education plan?
5. What are the components of the evaluation findings?

Key for self-assessment questions

1. Refer to 9.5.2
2. Refer to 9.5.5.1
3. Refer to 9.5.3
4. Refer to 9.5.5
5. Refer to 9.5.6